A REVISION OF THE TEREBRATULIDÆ AND LINGULIDÆ, WITH REMARKS ON AND DESCRIPTIONS OF SOME RECENT FORMS.

BY W. H. DALL, SMITHSONIAN INSTITUTION.

In the preparation of this paper I have been much indebted to the Smithsonian Institution, under the direction of Prof. Joseph Henry, for the use of its collection of recent Brachiopoda, and for the use of the cuts which illustrate the text of this article. I am under great obligations to Mr. F. B. Meek, of the Smithsonian Institution, for assistance, especially in regard to the fossil forms; his knowledge of the latter being only equalled by his kindness in imparting it.

I am also indebted to Thos. Davidson, Esq., F.G.S., &c., for much useful information and assistance, and for his unfailing courtesy in correspondence.

I have derived much assistance from the works of Messrs. Suess, Deslongchamps, Hall, King and Davidson, and especially from the admirable plates which accompany the excellent monographs of the last-named learned palæontologist.

The fact that I have departed from the arrangement hitherto in general use, is due to the belief that the practice of combining under one name forms differing in structure as well as detail, is detrimental to the interests of science. With few exceptions, the forms which I have separated sectionally, or generically, have been accurately figured and described by other authors; yet, in order to refer to them specially, the student must make a special study of all the forms, and search through paragraphs and pages relating to other forms which have been united with those of which he desires information; a course which, though popular from the greater latitude which it allows to the careless and superficial observer, is yet reprehensible, as destructive of the care and accuracy in detail which are so greatly needed in the study of recent as well as fossil forms.

The great interest which attaches to the theory of evolution renders close discrimination all the more valuable at the present day, whether the opinions of the observer incline to accept or to reject it.

Again, the whole system of nomenclature is only useful as an index to the members of the animal kingdom. The more accurate, full, and discriminating the index, the greater its value in generalization, and the more accessible becomes a true appreciation of natural laws. On the other hand, the combining in unnatural and heterogeneous groups, for purposes of convenience, forms which exhibit structural differences of greater value than the characters of the united group, is a course directly in opposition to all principles of science, and one which lays the greatest obstacles in the path of study. The argument used against an extended nomenclature, of its overtaxing the memory, &c., as Dr. Mörch truly observes, is unworthy a moment's consideration from scientific minds, and is only adapted for the non-scientific and popular masses. Such a train of reasoning carried to its logical conclusion would take us back to the system of Linnæus, or Aristotle himself.

In these remarks I must not be understood as reflecting in any way upon the very valuable labors of the authors above mentioned. To Mr. Davidson we are under great obligations, for restraining the premature *cacoëthes nominandi* in the group of *Brachiopoda*. However, I believe the time has arrived when our knowledge of the internal structure of these mollusks is sufficient to warrant their separation into natural groups, which should no longer be left without definite appellations.

The position of the *Brachiopoda* with respect to the other classes of the animal kingdom has been frequently the subject of discussion, but of late years naturalists have almost unanimously agreed in considering them as closely allied to the *Ascidians* and *Polyzoa*, and as occupying a place in that subdivision of the subkingdom Mollusca of Cuvier, to which the name *Molluscoidea* has been applied. The researches of Mr. E. S. Morse into the embryology of *Terebratulina septentrionalis*, would seem to substantiate this view entirely, and the only question still undecided would seem to be whether the *Brachiopoda* or the *Ascidia* should be considered as the most nearly allied to the *Lamellibranchiata*. As naturalists have generally come to the conclusion that linear classification is impossible, this point, though of interest, can hardly be said to be of great importance. But, more recently, Mr. Morse,* after enjoying great facilities for the study of the living animal of *Lingula*, has announced as his opinion, that the Brachiopods and Polyzoa must be removed from the mollusca including the Ascidians, and that the former are, as he expresses it, "true articulates and not mollusks, and that their proper place is among the worms, forming a group near the tubicolous Annelids."

---

* Silliman's Journal, July, 1870, p. 100.

A statement at once so startling and so utterly at variance with the received ideas upon the subject, naturally awakens a sentiment of opposition; such being the case, we should endeavor to use the utmost impartiality in discussion, and to give due consideration to the facts bearing upon either side of the question. It is, I believe, generally admitted that, in classifying forms which lie upon the boundaries of the great subdivisions so closely as to render their position a matter of doubt, a conclusion is more fairly reached by considering the sum total of the characters than by an exclusive classification based upon any one of them; and also that in arriving at a decision a comprehensive view of the general types of structure is more reliable than minor morphological considerations. Taking this view of the case, we may judge more clearly of the value of Mr. Morse's proposition by comparing the general structure of the Mollusca with that of the Annelids and then deciding from the facts, to which of them the structure of the Brachiopods and Polyzoa offers the greatest affinity.

Clark has shown very clearly* that the mollusca as a group are characterized especially by a bilateral development of single organs, that is, "among the zoophytes and articulates we find an excess of repetitions, of multiplicity of parts; but here (among the mollusca) every part or organ is single or in a single pair, and, instead of repeating itself, it develops its uniformity to relatively extreme proportions."

The main characters of the mollusca are as follows:

The *circulatory system* varies in extent, the ascidians possessing a simple unilocular contractile vesicle and incomplete vascular apparatus, while the cephalopod developes a trilocular heart with a distinct arterial and venous system. The heart, when it exists, is usually on the opposite side of the alimentary tube, from the principal nervous centre. The blood is colorless or colored.†

The *nervous system* essentially consists of a collar of nerves and ganglia around the oval opening or anterior portion of the alimentary tube. The principal nerve-mass is usually on the opposite side from the heart.

The *alimentary system* consists essentially of a tube invariably more or less bent upon itself, and in most cases with the excurrent orifice adjacent to the incurrent or oral opening.

---

* Mind in Nature, 1865, p. 195.

† Colored blood has been observed in *Chiton;* in *Tunicata* by Milne Edwards; the circulating fluid of *Hinnites* is of a deep wine-color.

The muscles of *Salpa* abound in transversely striated fibres While among the mollusca transverse bands of muscular fibre are not uncommon, yet these never enclose a succession of similar nervous, vascular or reproductive organs; nor do they include the whole body except in some *Tunicates.* The majority of the mollusca possess a calcareous shell, secreted by an organ called the mantle, to which they are permanently attached by strong muscles, and from which they cannot emerge and live. Our knowledge of their embryology is too limited to admit of sweeping generalizations.

Chitine is very generally secreted by them in the form of teeth, jaws, byssus, bristles* or opercula.

On the part of the Articulates, and especially the Annelids, their most strongly marked and typical feature is that of a repetition of similar parts; "we find it equally conspicuous among the internal organs, the intestines, heart, lungs or gills, nervous system and the reproductive system," "the highest of them do not attain to that singleness of character which exists even in the lower middle ranks of mollusca."†

Their principal structural characters are as follows:

The *circulatory system* is highly developed, complete and closed. The place of a heart is supplied by several large contractile vessels,‡ or by the contraction of the vascular channels or of the body itself.§ The vessels anastomose at both extremities, and by transverse vessels in the separate segments. The blood is colored or colorless.

The *nervous system* is composed of two cords which connect successive ganglia, or, instead, send off lateral branches at regular intervals, along the median line of the body, while the most anterior and principal ganglion lies above the œsophagus.‖

The digestive apparatus almost without exception opens by a mouth at the anterior end of the body and terminates by an anus at the posterior end. It is usually straight, rarely having convolutions and frequently divided by muscular constrictions into many sections.

The muscles of the Annelids, though highly developed, appear

---

*The bristles of *Chiton* are well known, in *Acanthochites* especially they are gathered in regular bundles, in follicles, corresponding to the segments of the shell, while in *Cryptochiton* they are spread over the entire surface.

† Mind in Nature, p. 214.

‡ Siebold. Anat. Inv., p. 167, et seq. Burnett's translation.

§ In the *Nemertoida.*

‖ Siebold, p. 156–60.

without notable exception to be destitute of transverse striations.*

The whole body is enveloped by subcutaneous muscular layers; (1) of transverse muscles; (2) of longitudinal muscles, and in many forms a third, of obliquely twisted fibres, is interposed between the two.

Such of the Annelids as possess a shelly covering form it by a secretion from a collar which surrounds the anterior extremity, which either deposits a calcareous matter or a fluid which serves to agglutinate grains of sand or other substances together to form a tube. But in no case are the inhabitants provided with permanent muscular attachments to such tubes; they can emerge without injury, especially when young,† and form another habitation without inconvenience. The shells of Annelids are always univalve, and no Annelid is known to attach itself by a byssus or by a portion of its integument, to any extraneous object.

In the Brachiopods and Polyzoa we find the following details of structure: while it is noteworthy that they are formed on the plan of uniformity, characteristic of the mollusca, and exhibit no trace of the reduplication of similar parts, which is the most salient feature of the Annelids and articulates in general. There is no vascular system or heart in the *Polyzoa*. The heart in the *Brachiopoda* is indistinct and the circulation is incomplete, recalling a similar condition of things among the ascidians. Two or four accessory, contractile vesicles assist in propelling the blood. They are distinct from the blood vessels, in which the circulation is assisted by ciliary action. The blood is colored as in *Chiton* and many Ascidians. The nervous system in the *Polyzoa* consists principally of a ganglion placed between the afferent and efferent openings as in Ascidians. In the Brachiopods it is more highly developed and consists of a series of ganglia and nerves, forming a collar surrounding the œsophagus "as in all true mollusks," with the greater portion of the ganglia below the œsophagus, while in worms it is above it.

The digestive canal is bent upon itself in both *Polyzoa* and *Brachiopoda*, without exception. This is doubtfully reported, as far as I know, of but one worm, a larval form (*Phoronis*); other characters of this Annelid will presently be mentioned. In some of the Brachiopods the canal is closed, while in others it opens laterally. It is never divided into sections by muscular constrictions as in worms.

---

* Siebold, l. c. p. 154. But one or two species of Annelids have been asserted to have striated muscular fibres.

† Johnstone, Cat. Brit. Nonparasitical worms, pp. 1 & 81.

The muscles of the *Polyzoa* are not striated; in arrangement they strongly recall those of *Salpa*. On the other hand the muscles of many of the Brachiopods are notable for their very conspicuous and remarkable striation.

The peduncle of *Lingula anatina* consists of four layers; an outer horny layer, imperforate and smooth, or slightly villous under a very high power, and transversely wrinkled by contraction into irregular annulations; second, a gelatinous, homogeneous layer of pellucid matter, probably of the same essential character as the outer layer, but softer; third, a very thin, delicate single layer of transverse muscular fibres ("delicate membrane," of Hancock) the most worm-like of all the characters of the group in question. But an exact parallel to the three layers just described may be found in the siphons of Lamellibranchs (for instance *Mya arenaria*) though the fourth layer, which in the Brachiopods is composed of simple longitudinal muscular fibres, is, in the other group, modified for the special use for which it is designed.* A similar arrangement of circular muscles is found in the higher Ascidians.

Finally, we find one special character worthy of mention upon which Mr. Morse has laid much stress, namely, the "bristles" which fringe the mantle-edge in most of the brachiopods, and which he has found "identical" with the setæ of worms.

These "bristles" or cirri in the brachiopods are very peculiar, and unlike anything reported by all writers on worms, accessible to me. They emerge one or two, or rarely more, from follicles on the edge of the mantle, exactly as we find the bristles of *Acanthochites* doing among the chitons. The bristles of *Plaxiphora*, however, are not homologous, being more accurately regarded as dermal prolongations. But, while seated in follicles, as among Chitons, the cirri of the brachiopods are less like Chiton-setæ than the latter are like worm-bristles. The last-mentioned are solid,† usually falciform, rarely jointed, and of homogeneous consistency, quite insoluble in boiling caustic potash. They are sometimes serrated, and often provided with a hook; and in the tubicolous Annelids are repeated with every segment. The Chiton-setæ resemble them in being solid, and homogeneous, but they are more simple in form, shorter, and in some species strengthened with a limy deposit.

---

*It is not impossible that, to some extent, the peduncle may be analogous to the siphon; especially as in Müller's figure of an embryonic *Discina*, a little organ below the mouth (which Morse compares with an Annelidan operculum) seems from its position, at least, to be analogous with the "foot" of bivalves, while the peduncle occupies relatively the same position that the siphon would.

† See Johnstone, loc. cit. p. 79, et. seq.

The cirri of the brachiopods are tubular and composed of two layers. The inner one is composed of slender, brittle, longitudinal fibres of chitine; the outer is membranous, very thin and regularly imbricated, the imbrications perhaps indicating stages of growth. In *Lingula anatina* and *Discina lamellosa* these bristles are covered with small short pointed *setellæ*, irregularly disposed upon the surface. These setellæ resemble the thorns upon a rose bush, being larger at the base, but the portion of membrane upon which they are seated is sometimes constricted below the base, giving them a pedunculated appearance. They are not articulated however as they might appear at first sight.

Some of the cirri are flattened a little and the transverse imbrications are closer than in some others. This may be due to differences in rapidity of growth.

When the cirri are boiled in caustic potash the outer membrane, *setellæ*, and most of the imbrications disappear entirely. Nothing remains but the chitinous tube, which, deprived of its envelope, splits readily into longitudinal fibres, or collapses.

When the difference in their construction and the fact that they are confined to the mantle edge and are not found upon the peduncle or other parts of the body, are recognized, it becomes very evident that they are by no means "identical" with the setæ of the worms.

The brachiopods are invariably attached by permanent muscles to bivalve shells, while the Annelids have no muscular connection with their univalve tubes of mud or sand. The fact that *Lingula pyramidata* forms a "sand-tube" about the peduncle, though interesting, has no bearing on the subject, since it is obvious that it cannot be formed in the same manner as the worm-tube, with which it might be compared, and does not bear the same relation to the animal.

The brachiopods are, as a rule, pedunculated and usually attached by their peduncles to submarine objects; *Lingula* forms no exception; though non-attached individuals are abundant, others of the same species are permanently fixed to stones or shells.

None of the Annelids are pedunculated nor attached by the integument to submarine objects. *Phoronis* and *Crepina*, larval Sipunculoid worms, which have been relied upon to bridge the chasm between the *Polyzoa* and the *Annelida*, have a distinct arterial and venous system, the latter, certainly, and the former, probably, have a straight intestine terminating in a posterior anus,* and in fact if the crown of ciliated tentacles be hidden, the sight, in the words of Van Beneden, the describer of *Crepina*, and a well known student of the Annelids and *Polyzoa*, is enough "to drive the very idea of a Polyzoön far away"!*

---

*See Strethill Wright, pp. 314–316, (Ed. new Philosoph. Journ. Vol. iv, 1856,) and compare Johnstone loc. cit. p. 266.

To conclude, it is impossible to avoid the impression that in hastily referring the Brachiopods and Polyzoa to the Annelids, Mr. Morse has judged the case on inadequate grounds, and from the evidence before us it is not unsafe to predict that they will remain in the future as in the past, unmolested among the Molluscoidea, with their nearest allies the Tunicates.

The recent observations of M. E. Deslongchamps on the spiculæ contained in the mantle and circulatory system of most of the genera, go far toward proving the erroneous nature of the homologies which have been drawn between the calcareous supports of *Thecidium* and the apophyses of other forms of *Brachiopoda*. This is elsewhere discussed.

I have preferred using the terms neural and hæmal to indicate the different valves, rather than the appellations ventral and dorsal, which can hardly be applied to the shells of this group. I have considered the pedunculated extremity of the shell as the posterior, and the opposite end as the anterior portions of the mollusk.

In the details of the apophyses, I have used terms whose meaning is sufficiently evident; dividing them into the *crura*, *hæmal processes*, *neural processes*, *lateral loops*, *neural loop*, *septal processes*, *lateral processes*, *septum*, &c., according to their relative position with regard to the shell, as will readily be understood.

The nomenclature of the figures is essentially the same as that of Woodward's Manual, in which most of them originally appeared.

As no list of the recent species of *Rhynchonella* has been lately published, I have added one, with appropriate references, for the convenience of students.

---

* Van Beneden, "*Notice sur un Annelid*," &c., Bull. de l'Ac. Royale de Belgique, 2d Series, V, 1858, p. 457.

NOTE.—I would add, that so far as I have carried my dissections of *Lingula anatina*, the results obtained agree entirely with those of Mr. Hancock, in his magnificent paper on the organization of the Brachiopoda; which stands unsurpassed in the annals of the comparative anatomy of invertebrates; and, while some of the surmises put forth in it have not been confirmed by further researches, yet in the laborious accuracy of the dissections it may ever serve as a model to students.

Synopsis of characters.

TEREBRATULIDÆ.—Punctate, foraminated, pedunculate, valves articulated. Brachiferous, with non-spiral apophyses.

TEREBRATULINÆ.—Hæmal valve bearing a simple loop, attached only to the hinge margin; provided with crura.

TEREBRATULA.—Loop simple, crura separated.

Terebratula.—Shell ovate. Brachia behind the mouth, provided with two lateral and a median spiral lobe.

Centronella.—Mesial sinuation of the loop prolonged neurally, as a thin lamina.

? *Epithyris.*—Hinge plate pointed, prolonged beneath the loop.

Pygope.—Shell bilobed when young; lobes uniting and leaving a central perforation, in the adult.

RENSSELÆRIA.—Hinge plate perforate internally. Anterior part of the loop pointed before, wider behind, long, with a slender process neurally perpendicular to the posterior edge.

TEREBRATULINA.—Loop with the tips of the crura united forming a more or less sinuous ring.

WALDHEIMIA.—Loop elongated and reflected, crura separated.

Cryptonella.—Loop with a transverse band uniting the apophyses behind the crura.

Waldheimia—Ovate, inflated; crura short, cardinal process and border moderate.

Meganteris.—Orbicular, compressed, nearly equivalve. Crura long, projecting over the edge of the reflected loop. Cardinal process and border, large.

STRINGOCEPHALINÆ.—Cardinal process produced and bifid. Loop not reflected, submarginal; attached to the crura by their neural edges (?); both valves with a septum.

STRINGOCEPHALUS.—Loop provided with thin processes converging internally. Neural septum fitting into the bifurcation of the cardinal process. Foramen very large, triangular, when young; round and small when adult.

MAGASINÆ.—Loop reflected, attached both to the hinge-line and to a hæmal septum.

TEREBRATELLA.—Apophyses with their hæmal arms connected with the septum by two septal processes.

Trigonosemus.—Area large, flat; beak produced; foramen minute, apical.

Lyra.—Beak much produced, divided internally by the prolongations of the dental laminæ.

Terebratella.—Shell usually ovate. Brachia with two lateral lobes meeting behind the mouth, median lobe absent, or obsolete. Septum not prominent, posterior neural loop free.

Laqueus.—Shell ovate, foramen usually entire, posterior neural loop attached on each side by slender processes to the hæmal processes, near the attachment of the septal processes.

Kingena.—Posterior part of the neural loop broad, angulated, with the corners brought down and attached to the septum. Exterior rough or pustulate.

Ismenia.—Lateral loops and neural loop broad, and blended posteriorly with the hæmal and septal processes, forming a broad funnel-shaped ring; lateral loops anteriorly open. Exterior as in *Terebratella.*

MEGERLEA.—Apophyses as in *Ismenia*, but lateral loops closed with calcareous matter. Shell transverse, hinge-line straight; striate outside, pustulate inside. Median brachial spiral lobe prominent. Brachia passing behind the mouth.

MAGAS.—Apophyses attached by the sides of the hæmal processes to the septum.

Magas.—Reflected portion of the loop incomplete.

Magasella.—Reflected portion of the loop complete.

KRAUSSININÆ.—No loop. Apophyses comprising two laterally extended lamellæ attached to the upper part of the prominent mesial septum of the hæmal valve.

KRAUSSINA.—Shell externally sculptured, beak truncate; foramen large, incomplete; septal lamellæ anteriorly inclined. Mouth behind the brachia, mesial spiral lobe minute.

BOUCHARDIA.—Shell externally smooth, beak produced; foramen minute, complete; septal lamellæ posteriorly inclined.

PLATIDIINÆ.—Brachia sigmoid, meeting behind the mouth; no spiral lobe.

PLATIDIA.—Loop simple, not reflected; attached to a mesial septum. No cardinal process. Foramen encroaching on both valves.

MEGATHYRINÆ.—Mouth central, surrounded by a membranous disk, bounded by non-spiral submarginal brachia.

MEGATHYRIS.—Hinge-line straight; loop not reflected, submarginal, attached. Mantle adherent to the shell.

Megathyris.—Foramen and area large. Shell sculptured. Loop attached to three or more submarginal radiating septa.

Cistella.—Shell smooth or sculptured. Loop attached to a single submarginal mesial septum, which interrupts the brachia.

* * * *

? THECIDIINÆ.—Shell attached by the substance of the neural valve, and with the foramen closed when adult. Young with a minute apical foramen. Loop entirely absent. Mantle supporting the brachia (which are non-spiral and irregularly lobed), and itself supported by a self-secreted irregular calcareous network.

THECIDIUM.—Shell thick, oval, rounded. Area large and flat. Crura united in a bridge over the visceral cavity. Brachia usually separated by a mesial ridge and its branches. Calcareous network variable.

NOTE.—*Eichwaldia*, Bill, which is doubtfully referred by Bronn to the *Terebratulidæ*, is founded on a shell (*E. subtrigonalis*, Rep. Prog. Can. Sur. p. 192, 1858) of which the internal structure is unknown, but which resembles externally, in the position of the foramen and general appearance, *Magasella Cumingii*, Davidson, sp., P. Z. S. 1852, pl. xiv, fig. 10—16. The genus was published in the Rep. on the progress of the Canadian Geol. Survey, 1858, p. 192, fig. 24, a to e, and the type is from the Coal Measures of Canada.

Leptocœlia, Hall, is closely related to *Atrypa*.

Hynniphoria, Suess, is unknown to me.

Tropidoleptus has been referred doubtfully, by Prof. Hall, to the *Terebratulidæ*. The type is *Strophomena carinata*, Conr. I do not feel sufficiently confident of its true position to admit it at present. The apophyses appear to resemble a *Magas*, without the upper reflected portion.

Vitulina, Hall, is somewhat undecided in its relations; *V. pustulosa*, Hall, is the type.—*Vide* Pal. N. Y., vol. iv.

TABLE OF CLASSIFICATION.

Those genera or species only found fossil, are in italics.

FAMILY.	SUBFAMILY OR SECTION.	GENUS.	SUBGENUS.	TYPE.
Terebratulidæ.	Terebratulinæ.	Terebratula.	Terebratula.	*T. maxillata.*
			Centronella.	*C. glans-fagea.*
			? *Epithyris.*	*E. elongata.*
			Pygope.	*P. diphya.*
		Rensselæria.		*R. ovoides.*
		Terebratulina.		T. caputserpentis.
		Waldheimia.	Waldheimia.	W. flavescens.
			Cryptonella.	*C. rectirostra.*
			Meganteris.	*M. Archiaci.*
	Stringocephalinæ.	*Stringocephalus.*		*S. Burtini.*
	Magasinæ.	Terebratella.	*Trigonosemus.*	*T. elegans.*
			? *Lyra.*	*L. Meadii.*
			Terebratella.	T. dorsata.
			Laqueus.	L. californicus.
			Kingena.	*K. lima.*

FAMILY.	SUBFAMILY OR SECTION.	GENUS.	SUBGENUS.	TYPE.
Terebratulidæ.	Magasinæ.	Terebratella.	Ismenia.	*I. pectunculus.*
		Megerlea.		M. truncata.
		Magas.	Magas.	*M. pumila.*
			Magasella.	M. Evansii.
	Kraussininæ.	Kraussina.		K. rubra.
		Bouchardia.		B. tulipa.
?	Platidiinæ.	Platidia.		P. anomioides.
	Megathyrinæ.	Megathyris.	Megathyris.	M. decollata.
			Cistella.	C. cuneata.
?	? Thecidiinæ.	Thecidium.		*T. pumilum.*
*	*	*	*	*
Lingulidæ.	Linguliinæ.	Lingula.		L. anatina.
		Glottidia.		G. albida.
		Lingulella.		*L. Davisii.*
		Trimerella.		*T. grandis.*
		Lingulepis.		*L. pinnæformis.*
	Obolinæ.	*Obolus.*		*O. apollinis.*
		Obolella.	*Obolella.*	*O. chromatica.*
			Kutorgina.	*K. cingulata.*
		Monobolina.		*M. plumbea.*
		Spondylobus.		*S. craniolaris.*
		?		*? polita.*

Family *TEREBRATULIDÆ.*

Shell punctate. Neural valve perforated at or near the apex, and attached to submarine objects by a peduncle passing through the perforation, or by a portion of the valve itself; provided with two teeth, which are articulated into sockets in the hæmal valve, which, in its turn, possesses a more or less prominent (cardinal) process which interlocks with the neural valve.

Animal with ciliated brachia more or less provided with non-spiral calcareous supports, which proceed from the hæmal valve.

Section TEREBRATULINÆ.

Hæmal valve with a simple loop proceeding from the hinge margin, more or less sinuate, and possessing two pointed processes or crura which have their origin near the hinge margin, to which alone the loop is attached. Deltidium composed of two pieces, often united.

Genus TEREBRATULA (Llhwyd), Auct.

Shell provided with a simple sinuous loop. Crura separated. Neural valve perforate at or near its extremity; attached by a pedicel.

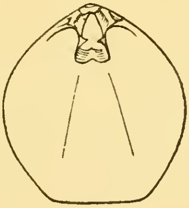


Fig. 1.

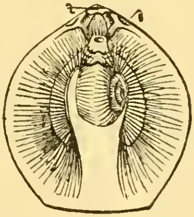


Fig. 2.

Fig. 1. *Terebratula vitrea*, Born, hæmal valve.
Fig. 2. Same, with the animal.

Subgenus Terebratula (Llhwyd), Auct.

Shell ovate, margin entire. Brachia passing behind the mouth, provided with two symmetrical lateral lobes and a double spiral median lobe.

Type. *Terebratula maxillata*, Sby., Min. Conch. p. 52, pl. 436, f. 4, 1822, =

T. minor subrubra, Llhwyd, Lith. Brit. Ichn. 1699, pl. xi, fig. 890.

The genus *Terebratula* of Llhwyd, who was not a binomial author, was adopted by Müller (Prodr. Zool. Dan. 1776, pp. xxxi and 249), although not in the restricted sense in which it is at present employed. His *Terebratulæ* embraced several species now distributed in different genera. In 1799, Lamarck, in his Prodr. Nouv. Class. des Coquilles, adopted the name, taking *T. perovalis*, Sby., as his type. This example has been followed by almost all subsequent authors. The generic term *Anomia* used for species of this family by Bolten (1798), Linnæus, and other authors, has in modern times, with equal unanimity been applied to a genus of Lamellibranchiate mollusca.

The type most commonly cited for the genus is the recent *Terebratula vitrea* of Born (= *Anomia terebratula*, Lin. Syst. Nat. 1153, and *Gryphus vitreo*, Megerle, Berl. Mag. 1811, p. 64), which inhabits the Mediterranean and is found fossil in the Pliocene deposits of Sicily.

TEREBRATULA UNGUICULA, Cpr.

T. unguicula, Cpr., Proc. Zool. Soc. Feb. 14, 1865, figs. 1 to 4, p. 201. Cooper, Geogr. Cat. of Cal. Mollusca, p. 3, No. 3.

Hab. San Diego, 6 fm.; Monterey, 20 fm., Cooper. Vancouver Id., Forbes. Sitka, under stones at low water; Unga Id., 4 fms., Dall.

This remarkable and very distinct species is provided in the young state with strong, radiating, simple ribs, and in this condition the hæmal valve resembles, exteriorly, a small *Pecten*. In older specimens the ribs bifurcate and become less pronounced, and the resemblance to a young *Terebratulina caput-serpentis* becomes more marked. The principal differences are that the *Terebratula* is rather the wider, and the intercostal spaces are more channelled than in the *Terebratulina*. Even these differences may not be constant in a large number of specimens. The broad incomplete loop, of course, is abundantly sufficient to identify this species. The umbo of the neural valves is sharply pointed in perfect specimens; the foramen is large and incomplete, the area smooth and very short; there is no deltidium, and the pedicel is usually stout and short.

Smithsonian Cabinet, 14,789, 14,892, 15,264.

No. 16,232, a single valve from Neeah Bay, appears to be *Terebratella caurina*, Gould, jun., worn.

Subgenus CENTRONELLA, Bill.

Centronella, Billings, Can. Nat. iv. 1859, p. 131. A. J. Sci. vol. 36, p. 237.

Shell resembling *Terebratula*, but with the mesial sinuation of the loop prolonged toward the neural valve, in the shape of a thin lamina.

Type. *Centronella glans-fagea* (Hall sp.), Bill., in Can. Nat. 1859, p. 131, fig. 1 to 5, and Am. Journ. Sci. xxxvi, p. 237, fig. 8.

Fossil in the Devonian of Canada. Plate vi, fig. 8.

? Subgenus EPITHYRIS, King.

Epithyris, King (not Phillips), Perm. Foss. p. 146, 1850.
Seminula, M'Coy, Br. Pal. Foss. 1855 (not = *Seminula*, M'Coy, 1844).
Dielasma, King, Proc. Dub. Univ. Zool. and Bot. Assoc. vol. i, 1859, p. 260.

Shell with lamellæ supporting the teeth of the neural valve, a short loop as in *Terebratula*, but more abruptly sinuated anteriorly, and with the central lamina of the hinge plate, in the hæmal valve, produced in the form of a mason's trowel, and supported beneath by a mesial septum.

Type. *Epithyris elongata*, King, = *Terebratulites elongatus*, Schloth. Fossil, Permian. Plate viii, fig. 7, after Davidson.

Mr. Davidson's figure in the Permian Brachiopoda represents the hinge lamina as produced almost as far as the loop, and very prominent; those of Prof. King in the Permian Foss. show little more than may be observed in various species of different genera in this family. If the last-named figures be correct, the group is hardly of subgeneric value.

Epithyris of Phillips (Pal. Foss. 1841, p. 55) was not sufficiently characterized, and no type was mentioned. Hence the name was still available, as it represented nothing. Prof. King applied it to this species and others allied to it, naming and figuring the species above mentioned as his type. In 1844 Prof. M'Coy had given the name *Seminula* to a group belonging to the

Helictobrachiata, composed of an *Athyris* and two species of *Rhynchonella.* This fell to the ground, and in 1855 he proposed to apply the name to the group already characterized by King as *Epithyris.*

Under the impression that his early name was inadmissible, Prof. King again described the group, with the same type, under the name of *Dielasma.*

According to the strictest rules of nomenclature *Epithyris* must take the precedence, and *Dielasma* be considered as a synonym.

Subgenus PYGOPE, Link.

Pygope, Link, Physik. Erdbeschr. ii, 1830. King, Perm. Foss. p. 144, 1850. Woodw., Man. Rec. and Foss. Shells, p. 215, pl. xv, fig. 2.

Antinomia, Catullo, Quart. Journ. Geol. Soc. vol. vii, 1850, p. 74.

Loop as in *Terebratula.* Shell punctate. Young bilobed, the emargination being in the median line. In the adult the inner edges of the valves unite, leaving a circular perforation in the centre of the shell.

Type. *Pygope diphya*, = *Terebratula diphya*, v. Buch, Ueb. Ter. p. 88, pl. 1, fig. 12.

Fossil in Jurassic beds of Europe.

The very remarkable conformation of the adult shell cannot have been without some corresponding differences in the soft parts, and is sufficient to entitle the group to subgeneric rank, although the apophyses resemble *Terebratula.*

Another species, *P. diphyoides*, d'Orb. (Pal. Fran. Ter. Cret. iv, p. 87, pl. 109), is found in the Neocomian of France.

The recent species of the genus *Terebratula*, not previously mentioned, are:

Terebratula uva, Brod., P. Z. S. 1833, p. 124. Hab., Gulf of Tehuantepec, Cuming; Falkland Ids., Davidson.

? *Terebratula minor*, Phil. and Suess., Dav. Ann. Nat. Hist. 1861, p. 35. Hab., Mediterranean.

Terebratula Davidsoni, A. Adams, P. Z. S. 1867, p. 314, pl. 19, fig. 30. Satanomosaki, Japan, 55 fathoms.

?? *Terebratula transversa*, Gould, Proc. Bost. Soc. Nat. Hist. vol. vii, p. 323, Sept., 1860. Otia Conch., p. 120. Dav., Ann. Nat. Hist. 1861, p. 38. (Not *T. transversa*, Sby., which is a synonym of *T. dorsata*, Lam.) Suess. Wohns. i, p. 27, 1859.

The type of this species is not to be found, and I am unable to suggest its proper place from Dr. Gould's description. Suess (l. c.) refers it to *Megerlea*. Hab., Hakodadi Bay, Japan.

Terebratula cubensis, Pourt., Bull. Mus. Comp. Zool. No. 7, p. 109. W. Indies.

Genus RENSSELÆRIA, Hall.

Atrypa, Conrad, Ann. Rep. Geol. of New York, 1839, p. 45.

Pentamerus, Vanuxem, Journ. Phil. Ac. Nat. Sci. viii, p. 266, 1843.

Meganteris, Hall, An. Rep. Reg. Univ. N. Y. Pal. Foss, 1857.

Rensselæria, Hall, 12th An. Rep. Reg. Univ. N. Y. p. 39, Oct. 1859.

Shell punctate, inequivalve; neural valve with a prominent apex; foramen complete or incomplete, terminal, sometimes concealed. Teeth supported by receding plates, which are attached in the cavity of the apex of the neural valve; septum present.

Haemal valve with a more or less prominent hinge plate and cardinal process. The hinge plate is perforated near the apex of the valve, forming a communication with the cavity of the umbo.

Two moderately stout processes are given out from the hinge upon which the crura are attached at a strong angle, projecting above and below, and at the lower extremity giving off the main branches of the apophyses about at a right angle. The latter are produced anteriorly, meeting, and forming a sharp point connected by a thin plate of shelly matter, at the posterior edge of which, in the median line, a slender process is projected upward, nearly parallel with the crura, toward the neural valve.

Type. *Rensselæria ovoides*, Hall = *Terebratula ovoides*, Eaton, Geol. Textb. 1832, p. 45.

Fossil in the Lower and Upper Helderberg and Oriskany beds of New York.

Prof. Hall has aptly compared a view of the apophyses with the tongue of a bird having the hyoid bones attached.

Genus TEREBRATULINA, D'Orb.

Terebratulina, D'Orb., Comptes Rendus xxv, p. 268, 1847.

Shell with the foramen incomplete and deltidium usually rudimentary. Crura united at their tips in the adult, forming a more or less sinuous ring.

Brachia as in *Terebratula*.

Type. *Terebratulina caput serpentis.* L. sp.

Anomia caput serpentis, Linn., Syst. Nat. ed. 12, 1153, 1767.
Terebratulina caput serpentis, D'Orb., Ann. Sci. Nat. viii, 67, pl. vii, fig. 7, 8, 17, 1848.
Terebratulina cornea, D'Orb., 1848.
Terebratula pubescens, Retz., N. Gen. 15.
Anomia retusa, Linn., S. N. 12, p. 1151.
Delthyris spatula, Mke., Syn. ed. 2, 96.
Terebratula aurita, Flem., Phil. Zool.
Terebratula costata, Lowe, Zool. Journ.
Terebratula striata, Leach, Br. Moll.
Terebratula Gervillei, S. Wood, Mag. N. H. v, p. 253.

Hab. North and East Atlantic. Smithsonian Cabinet, 14, 187.

Fig. 3.

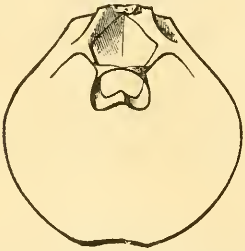


Fig. 4.

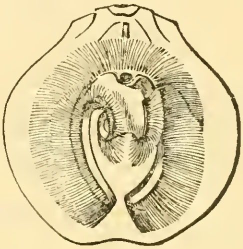


Fig. 3. *Terebratulina caputserpentis*, D'Orb., hæmal valve.
Fig. 4. Same, showing the animal.

This species, by the coarser and rougher striæ, and usually more elongate and less inflated valves, seems sufficiently distinguished from *T. septentrionalis*, Couth.

It is reported from Japan, by A. Adams. Perhaps his specimens may have been *T. augusta*, Ad. (= *T. Japonica*, Sby. teste Rve.), or possibly *Terebratula unguicula*, Cpr.

The other recent species of this genus are:

Terebratulina Japonica, Sby., Thes. Conch. vii, p. 344, pl. 68, fig. 7, 8. Hab. Japan.

? *Terebratulina Cumingii*, Dav., P. Z. S. 1852, p. 79, pl. xiv, fig. 17, 18, 19. Hab. China Seas, Japan.

Terebratulina abyssicola, Ad. and Rve., Voy. Samarang, Moll. p. 72, pl. xxi, fig. 5. Hab. Gulf of Corea.

Terebratulina radiata, Rve., Conch. Icon. pl. iii, fig. 7 a, 7 b. Hab. Gulf of Corea, Belcher.

Terebratulina cancellata, Koch, Kuster Conchyl. Cab. v, vii, pl. ii b, fig. 11 and 15. Hab., West Australia, Suess.

Terebratulina Caillettii, Crosse, Journ. de Conchyl. 1865, p. 27, pl. i, fig. 1, 2, 3. Hab. West Indies.

Genus WALDHEIMIA, King.

Waldheimia, King, Perm. Foss. p. 81, 1850.

Macandrevia, King, Proc. Dub. Univer. Zool. and Bot. Assoc. 1859, p. 261.

Eudesia, King, Perm. Foss. p. 144.

Lampas, Humph. (pars.)

? *Rynchora*, Dalm. (pars.)

Waldheimia, Woodw., Gray, Dav. and the generality of authors.

Loop elongated and reflected, without secondary attachments.

Fig. 5.

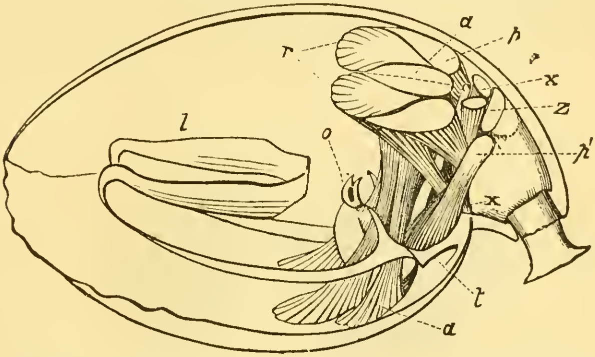


Fig. 5. Muscular system of *Waldheimia*. $\frac{2}{1}$ nat. size, after Hancock. *a*, *a*, adductors; *r*, cardinals; *x*, accessory cardinals; *p*, *p′*, *z*, pedicel muscles; *o*. mouth; *l*, apophyses; *t*, dental socket.

Subgenus CRYPTONELLA, Hall.

Loop exactly resembling that of *Waldheimia*, proper, except in the addition of a transverse band from one side of the apophyses to the other, behind the crura.

Cryptonella, Hall, 14th Rep. Reg. Univ. N. Y. 1861, p. 102, 20th Rep. 1867, p. 20, 21. Pal. N. Y. vol. iv. pp. 392, 393.

Type, *Terebratula rectirostra*, Hall. Fossil in the Devonian of New York.

This genus has hitherto been confounded with *Centronella*, Billings, from which it would now appear to be quite different.

Subgenus WALDHEIMIA.

Shell globose, neural beak more or less produced; foramen complete or incomplete. Deltidia separated or united; pedunculated; a ridge or septum usually existing in the hæmal valve.

Mouth behind the brachia, which consist of two lateral lobes and a central spiral lobe.

Fig. 6.

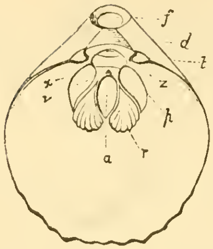


Fig. 7.

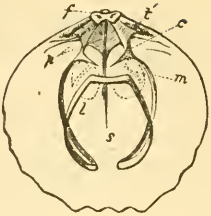


Fig. 6. Neural valve of *Waldheimia flavescens*. *f*, foramen ; *t*, teeth ; *d*, deltidium ; *a*, single adductor scar ; *r*, cardinal muscle scar ; *x*, accessory muscle scar ; *p*, pedicel muscle scar ; *z*, pedicel attachment.

Fig. 7. Hæmal valve of the same. *j*, cardinal process ; *t′*, dental sockets ; *p*, hinge plate ; *s*, septum ; *c*, crura ; *l*, neural loop ; *m*, adductor scars.

Fig. 8.

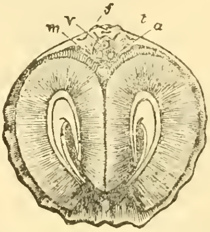
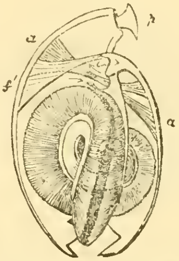


Fig. 9.



Figs. 8 and 9. Side and neural views of the animal of *Waldheimia flavescens* in the shell.

Type. *Waldheimia flavescens.*

T. flavescens, Val. apud Lam., Anim. sans Vert. v, vii, p. 330. Rve., Conch. Iconica, pl. i and pl. ii a, b.
Terebratula dentata, Val.
Terebratula australis, Q. and G.
Terebratula recurva, Q. and G.
Waldheimia australis, King, Mon. Perm. Foss. p. 145. Davids. Int. Br. Foss. Brach. p. 65, pl. vi, fig. 9, 10.

Hab. Australia. Smithsonian Cab. 17814.

Most of the specimens of this species are radiately ribbed; some, however, are quite smooth, especially the smaller specimens.

In the latter the foramen is barely complete. There are considerable variations in the amount of inflation, and the form varies from ovate to transverse.

WALDHEIMIA VENOSA, Sol. Plate viii, fig. 8 and 11.

Anomia venosa, Sol. MSS. Mus. Banks. Dixon's Voy. p. 355, pl. xi, 1788. Dav., Ann. and Mag. Nat. Hist. xx, p. 81—83.
Terebratula globosa, Lam., An. s. Vert. v, vii, p. 330. Rve., Conch. Icon. pl. ii. fig. 3 a, b, c, pl. vi, fig. 3 d, e. Jour. de Conchyl. 1861, p. 122.
Terebratula californica, Sby., Auct. (non Koch).
Waldheimia dilatata, Lam., Rve., Conch. Ic. pl. ii, fig. 2, pl. vi, fig. 2 b, 2 c.
Terebratula Gaudichaudi, Blainville (teste Rve).
Waldheimia physema, Val., Rve., Conch. Ic. vi, fig. 25 a, b, c.
Terebratula eximia, Philippi (teste Rve.)
Terebratula Kochii, Kust., Conch. Cab.
Terebratula Fontaineana, D'Orb., Voy. Am. Mer. v. p. 675, No. 782 ; ix, pl. 85, fiig. 30, 31.

Hab. Orange Harbor, Tierra del Fuego. U. S. Ex. Ex. Smithsonian Cabinet, 17,813.

Of the shells submitted to Mr. Reeve for examination, collected by the U. S. Exploring Expedition, fifteen specimens were returned by him under this name. Externally they presented no differences among themselves except in size and coloration. An examination of the apophyses showed that, of the whole number of specimens, three belonged to a different genus, while ten retained no remains of the apophyses. The latter, probably, and the two perfect specimens, certainly, were correctly determined.

This shell does not agree with Sowerby's description as given in the Br. Mus. Cat. p. 59.

In all the specimens examined except one the foramen was complete ; in that one a slight fissure existed, seemingly the result of erosion. This character, however, is by no means to be relied upon, as it is not constant in many of the species.

The apophyses are very slender and narrow, a breath almost being sufficient to destroy them. The cardinal process is very prominent, and terminates in two rounded knobs.

The beautiful red, vein-like markings, present in most of the specimens, are simply the remains of the ovaria. They are entirely composed of animal matter, and may be washed entirely away with water. Hence they cannot be relied upon as a diagnostic, though much more permanent than the remainder of the animal matter.

The form of the shell varies from elongate oval to nearly circular, with or without an anterior flexure.

WALDHEIMIA CRANIUM, Mull.

Terebratula cranium, Mull., Prod. Zool. Dan. p. 209. Rve., Conch. Icon. pl iii, fig. 6. Journ. de Conchyl. 1861, p. 123. Jeffreys, Brit. Conch. ii, p. 11, v, p. 163.
Terebratula vitrea, Flem. (non Born.)
Terebratula subvitrea, Leach (teste Rve.)
Terebratula glabra, Leach, Brit. Moll. p. 359, pl. xiv, fig. 3, 4, 5.
Macandrevia cranium, King.

Hab.—Norway, McAndrew, Smithsonian Cab., 13,979.

The foramen of this species is incomplete, and the area very small. The loop is deeply reflected and of extreme tenuity. The shells vary in their different stages of growth from lenticular to ovate globose.

Prof. King, whose perception of differences of structure is remarkably keen, separated this species from *Waldheimia*, under the name of *Macandrevia*, on account of the absence of the septum and flat central lamina of the hinge plate, in the hæmal valve, and the want of the laminæ which support the teeth, in the neural valve of the typical species, as well as the incomplete foramen.

I have shown elsewhere in this paper that the foramen may be complete or incomplete in the same species, that the dental laminæ of the neural valve may also be present or absent in the same species (e. g. *Laqueus suffusus*), that the mesial septum may be found in some species of a genus and not in others, that in some species the dental laminæ may be absent in the neural valve while the central lamina of the hinge plate is still to be found in the hæmal valve (e. g. *W. Raphaelis*) and, therefore, I cannot consider the structure in question as of even subgeneric value.*

WALDHEIMIA GRAYI, Dav.

W. Grayi, Dav., Proc. Zool. Soc. 1852, p. 76, pl. xiv, fig. 1, 2, 3. Rve., Conch. Iconica pl. ii, fig. 5, a, b, c. Journ. de Conchyl. 1861, p. 123. Cpr., Suppl. Rep. Br. Assoc. 1863, p. 636. Cooper, Geogr. Cat. Moll. 1867, p. 3.

Hab. Catalina Id., Coop. Corea, Belcher. Monterey, Dall. Smithsonian Cabinet, 401, Cp.; 1651.

This a good deal resembles *Kraussina capensis* externally.

The red bands of color in this fine species are sometimes absent. In such cases it is impossible to distinguish it from varieties of *Terebratella caurina*, Gld., except by the apophyses, which are not attached, and by the absence of a septum. The foramen is usually larger in this species, in proportion to the size of the shell, and the hinge line usually more curved, but these differences are inconstant. The deltidia in the largest specimen are firmly united, in three or four others they are widely separated. The blood of this species is red.

---

* Mr. W. G. Binney (Inv. Mass. 2d ed. p. 211), has placed this species in the family *Rhynchonellidæ*!!

This species has been termed *Eudesia Grayi* by some authors, but as the plaits, which were the characters upon which the genus *Eudesia* (type *Wald. cardium*, Val.,) was founded, are inconstant characters and by no means of generic value, I cannot consider the plaited species as sufficiently distinct to deserve separation from the other species of the genus.

WALDHEIMIA RAPHAELIS, n. s. Plate vii, fig. a, b, c, d.

Hab. Japanese coast near Yeddo, R. Pumpelly. Smithsonian Cabinet, 11786.

Shell ovate, truncate anteriorly; beak recurved, produced, somewhat pointed. Foramen complete, moderate; area large, ill defined; deltidia united, moderate. Neural valve smooth, obsoletely marked with lines of growth. Anterior edge doubly emarginate, with the median portion somewhat produced; with corresponding median emargination and double lateral prolongation of the anterior margin of the hæmal valve. The lateral margins of both are nearly straight.

The hinge-line is greatly arched; there are no plate-like dental supports; the shape of the muscular impressions on the neural valve is best shown by the figure. They are proportionately smaller than in *W. flavescens*.

The hinge plate of the hæmal valve is broad and somewhat excavated between the median line and the hinge teeth. The plate forms a triangular table, so to speak, which lies flat on the posterior part of the septum. The cardinal process is rhomboidal and stout. The loop is very broad in the reflected portion; the crura are slender, sharply pointed, and strongly curved at the tips. The septum is about half as long as the valve.

The color of the shell is a somewhat deep brown with a slight rufous tinge. Externally the valves are conspicuously and regularly punctate. The punctures are of an oval shape outside, and smaller, more distant, and circular within.

This species differs widely from all described recent forms. It is named in honor of the collector, Prof. Raphael Pumpelly, the indefatigable geologist, who has added so much to our knowledge of Japan.

The other recent species of this group are:

Waldheimia lenticularis, Desh., Mag. Zool. 1841, pl. xli. *Hab.* Strait of Fauveau, New Zealand.

Waldheimia picta, Chemn., Sby. Thes. Conch. vii, p. 351, pl. 70, fig. 43, 44. *Hab.* Java, Japan.

Waldheimia septigera, Lovèn, Index Moll. Scandin, 1846, p. 29. *Hab.* Norway; Japan.

Waldheimia floridana, Pourt., Bull. Mus. Comp. Zool. No. 7, p. 127. *Hab.* West Indies; Florida coast.

Subgenus MEGANTERIS, Suess.

Meganteris, Suess., (not Hall) Sitz. Ak. Wiss. Klas. Math. xviii, 1856, p. 51, pl. i, figs. 1, 2, 3, 5, 16 and pl. iii, figs. 3 a, 3 b, (*M. Archiaci*).

Shell orbiculate, somewhat compressed, nearly equivalve. Area of neural valve small, apex inconspicuous, minutely foraminated, punctate. Deltidia small, wide, united. Cardinal process prominent, with a V-shaped process near the apex for the insertion of the cardinal muscles, sulcated on each side, with the base excavated. Cardinal border broad, wide, rugose. Loop essentially as in *Waldheimia*, but with very long crura, the main stems of the apophyses being given off at a sharp angle with the crura, reflected abruptly and the posterior part of the reflected loop behind and below the crura. There is a faint mesial septum in the hæmal valve.

Type *Meganteris archiaci*, Suess. Plate viii, fig. 12, 12a. Fossil in the Devonian of the Eisel.

? Section STRINGOCEPHALINÆ, Dav.

Stringocephalidæ, Dav., 1851, Int. Brit. Brach. p. 73. Loop attached to the crura by their neural edges ?

Genus STRINGOCEPHALUS.

Stringocephalus, Dav., (emend) Int. Brit. Brach. p. 73, 1851.

Strigocephalus, Defr. Dict. Hist. Nat. Vol. li, p. 102, pl. 75, fig. 1, 1a, 1827.

Fig. 10.

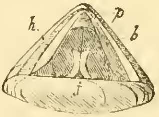


Fig. 10. Young shell, $\frac{4}{1}$ nat. size. *h*, hinge area; *b*, deltidium; *p*, pseudo-deltidium.

Animal unknown, pedunculated. Foramen large, triangular in the young; small and oval in the adult; deltidium composed of three elements. Neural valve with a pointed apex and a well developed septum. Hæmal valve with a very prominent cardinal process, forked at the extremity (to receive the edge of the neural septum), provided with a mesial septum. The lower portion of the hinge plate supports the crura of the loop in the shape of two flattened lamellæ, which, after proceeding with a slight upward curve to near the extremity of the septum, are suddenly reflected and again approach the sockets before sweeping submarginally around in the form of a large wide loop, from the inner edge of which a number of smaller lamellæ branch off and converge.

Fig. 11.

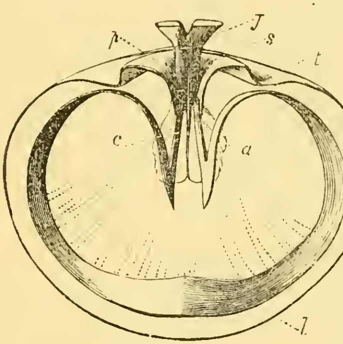


Fig. 12.

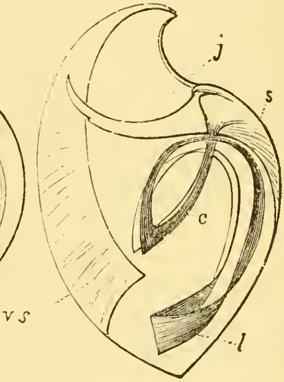


Fig. 11. Hæmal valve of *Stringocephalus Burtini.*
Fig. 12. Profile of shell of same. *a*, adductor scar; *j*, cardinal process; *p*, hinge plate; *s*, hæmal septum; *vs*, neural septum; *t*, dental sockets.

Type *Stringocephalus Burtini*, Defr., Woodw. Man. Rec. and Foss. Shells p. 222, figs. 130, 131, pl. xv, fig. 13.

With regard to the position of this genus in the arrangement, I must dissent entirely from the opinion of M. Suess., who places it in the vicinity of *Megathyris*.

The reflection of the apophyses from the neural edge of the crura (if correctly restored) is a remarkable feature, and the most casual examination of the loop of *Megathyris* will show that it is totally different, the reflection in the last named genus being from the outer and *hæmal* side of the crura, as in all the other genera of the *Terebratulidæ*, which possess a loop. The lamellæ, which have occasionally been noted on the inner edge of the loop of *Megathyris* are features of the most trivial nature, and analogous instances are found in other species belonging to totally different genera, for instance *Terebratella pectunculus*, Schloth., Dav. An. of Nat. Hist. 1850, pl. xv, figs. 5. a, b. The structure of *Stringocephalus*, while sufficiently distinct to deserve a section to itself, is most nearly allied to that of the septate *Waldheimias*, near which I have placed it.

Stringocephalus, according to Mr. Davidson, has only been found in strata of the Devonian age.

Messrs. White and St. John have provisionally indicated a new form under the name of *Cryptacanthia*, (Trans. Chicago Acad. Sci., i. p. 119, 1868,) which presents some analogies with *Stringocephalus*, *Waldheimia* and *Terebratulina*. "The loop seems to be essentially like that of *Waldheimia* in form, but the crura of the loop appear to be joined, * * * and the loop-band is armed with numerous spines which point outward toward the shell (?) in all directions," W. and St. J. loc. cit. It cannot be determined from this description whether the spines are directed toward the margin or the body of one of the valves, but it affords another argument against affiliating *Stringocephalus* with *Megathyris* from the mere presence of such appendages.

Type *Waldheimia? compacta*, W. and St. J. Tr. Chic. Acad. Sci. I., p. 119, fig. 3, a, b, c.

Section MAGASINÆ.

Magasina, Gray, B. M. Cat., p. 85, 1853.

Loop reflected, attached both to the hinge margin and to the septum of the hæmal valve.

Genus TEREBRATELLA.

Apophyses with their hæmal arms connected with the septum by two (septal) processes.

Subgenus TRIGONOSEMUS.

Trigonosemus, König, Icon. Sect. 1825, p. 3, f. 73. (*T. elegans*).

Fissurirostra, D'Orbigny, Pal. Fran. Cret. p. 133, fig. 520. (*F. recurva*), 1847.

Fissirostra, D'Orb., Cours. El. Pal., p. 89, 1849.

Shell with produced curved beak or umbo in the neural valve; a minute apical foramen; a large triangular area, flat and marked by the outline of the flat deltidium; cardinal process very prominent. Loop as in *Terebratella*.

Type *Trigonosemus elegans*. König. Fossil in the Cret.

I can only concur with Mr. Davidson in considering this sec tion as not entitled to generic rank. It may be as well to retain it for the group it indicates, in a subgeneric sense, as it is prior to *Terebratella.*

? Subgenus LYRA.

Lyra, Cumb., Sby. Min. Conch., 1816, (*L. Meadii*).
Terebrirostra, D'Orb., Pal. Fran. Cret. iv, p. 146, 1847. (*T. lyra*), Dav., Brit. Fos. Brach., p. 67.
Trigonosemus, (part), König, (*teste* Dav.)
Waldheimia, (part), Gray, Cat. Brach., p. 82.

Shell having the back of the neural valve very long, almost straight, with a false area and narrow deltidium; divided lengthwise internally by the dental plates; truncated and perforate at the extremity. Loop unknown.

Type *Lyra Meadii*, Cumberland. Foss. Cretaceous.

D'Orbigny, Davidson and Woodward seem inclined to place this subgenus under *Terebratella*, as having the loop attached to the septum; while Gray places it as a section of *Waldheimia.* This group had also better be retained for the same reasons given in regard to *Trigonosemus.*

Subgenus TEREBRATELLA, D'Orb.

Terebratella, D'Orb., Pal. Fran. Ter. Cret., vol. iv, p. 110, 1847. Dav. Int. Brit. Brach., p. 65, (*T. dorsata*).
? ? *Delthyridæa*, McCoy, Syn. Carb. Foss. Ir., p. 130, 1844, fig. 27.
Delthyris, Menke, (not Dalman or v. Buch,) Syn., ed. ii, p. 96, (*D. dorsata*, Lam.), 1830.

Shell with a moderate beak on the neural valve; usually truncate and somewhat recurved, fixed by a peduncle passing through the foramen. The latter is usually incomplete and the deltidia consequently separated. An indistinct ridge or septum sometimes exists in the neural valve.

Brachia composed of two lateral loops, the posterior limbs of which meet behind the mouth and the anterior before it. The central spiral lobe is obsolete or entirely absent.

This section contains the typical forms of the genus and almost all the recent species. The fossil representatives range from the Cretaceous upwards.

The diagnosis of *Delthyridæa*, as far as external characters go, would well agree with such species as *T. caurina*, but according to Mr. Davidson no type was given by Prof. McCoy, and his figure is unrecognizable. Dr. Gray gives *T. pectiniformis* as

McCoy's type; it is also one of the types of Dalman's troublesome genus *Rhynchora* and is placed by Gray in the subgenus *Lyra* (Cumb. 1816).

Dalman's first species of *Delthyris* was *D. elevatus*, a true *Spirifer* of the Silurian age. Menke quotes the name *Delthyris* with its proper synonyms and gives *Terebratula dorsata* and *T. caput serpentis* as examples. But, since neither of these species was included in Dalman's list of Delthyrides, the reference of Menke could not be construed so as to allow of the application of *Delthyris* as a generic name to either of the two species he cites. Hence *Delthyris*, Menke, must stand as a synonym of *Terebratella*, while *Delthyris*, Dalman, bears the same relation to *Spirifer*.

Fig. 13.

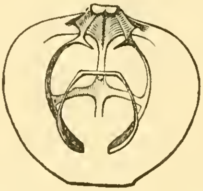


Fig. 13. *Terebratella dorsata*, hæmal valve, showing apophyses.

Type TEREBRATELLA DORSATA, Lam.

Anomia striata magellanica, Chemn. Conch. Cab. v. viii, p. 101, pl. 78, fig. 710, 711.
Terebratula Magellanica, Rve., Conch. Ic., pl. v, fig. 21, a, b, c, d. J. de Conchyl. 1861, p. 127.
Terebratula dorsata, Lam., An. Sans. Vert. v. vii, 1819, p. 331.
Anomia dorsata, Gmel. 1788, S. N. 3348.
Terebratula Chilensis, Brod., P. Z. S. 1836, 134.
Terebratella Sowerbyi, King, Zool. Journ. v, p. 338.
Terebratula bilobata et *pectinata*, Blainv., Teste Rev. Journ. de Conchy. 1861, p. 127.
Delthyris dorsata, Mke., Syn. Ed. 2, 1830, p. 96.

Hab. Coasts of Chili southward to the Straits of Magellan. Smithsonian Cab. 17822, 17815. As Chemnitz was not a binomial writer, his name cannot be retained.

From the specimens and descriptions at hand I can only agree with Reeve in uniting the above synonyms under the name of *dorsata*. Of six specimens received from Mus. Cuming, under this name, two were *Terebratellas*; the remainder belonged to the genus *Magas*. *T. transversa*, Sby., probably belongs to this species.

TEREBRATELLA CRUENTA, Dillwyn.

Anomia cruenta, Dillw., Syn. p. 295, 1817.
Terebratula rubra, Sby., Thes. Conch. pl. lxviii, fig. 9—11.
Terebratula zelandica, Desh., 1830, Mag. Zool. pl. 42, 1841. Sby., Thes. vii, p. 361, p. lxxii, fig. 111, 113.
Terebratula zelandica, Dav., An. N. H., p. 367, 1852.
Terebratula sanguinea, Leach, Zool. Miscell., pl. 76. Lam. An. Sans. Vert. vi, p. 243. Donovan. Nat. Repos., pl. 34.

Hab. New Zealand. (Mus. Cuming). Smithsonian Cabinet, 17,823.

Some odd valves, named by Mr. Cuming, of this species (?) have absolutely nothing to distinguish them from varieties of the next species.

TEREBRATELLA RUBICUNDA, Sol.

Anomia rubicunda, Sol. MSS. Mus. Banks.
Terebratula rubicunda, Donovan, Nat. Rep. pl. 56, fig. 2—4. Sby., Thes. Conch. vii, p. 351, pl. 70, fig. 45—47. Dav. An. Nat. Hist. p. 367, 1852.
Terebratella rubicunda, Rve., Conch. Icon. pl. vii, fig. 27 a, b. Journ. de Conchyl. 1861, p. 129.
Terebratula inconspicua, Sby. (testa juvenis fide Rve.), Thes. Conch. vii, p. 359, pl. 71, fig. 102—104.

Hab. New Zealand. U. S. Exploring Exp. Smithsonian Cabinet, 17,824.

Among a large number of specimens of this species, obtained by the naturalists of the Exploring Expedition, great variations may be observed. Some of them are smooth and polished; others rude, coarsely striated with the lines of growth or radiating striæ. The foramen is small and complete, with a wide and solid deltidium; while in others, of the same size, the foramen is large, incomplete, and the deltidia widely separated. Some are nearly twice as long as wide, others wider than long. Some are distinctly trilobed, others are ovate and smooth. The mesial ridge in the neural valve is usually present. Some of the specimens appeared absolutely identical with valves sent, as of the last species, from Mus. Cuming.

TEREBRATELLA PULVINATA, Gld.

Terebratula pulvinata, Gld., Proc. Boston Soc. Nat. Hist. Dec. 1850. Exp. Sh. p. 468, pl. 44, fig. 581.
Waldheimia pulvinata, Gld., Otia Conch. (emend) p. 97, 1862.

Cpr., Sup. Rep. Br. Assoc. 1864, p. 636. Suess, Wohns. i, p. 20, 1859.

Terebratella pulvinata, Cpr., Check List West Coast Shells, June, 1860.

Waldheimia pulvinata, Cooper, Geog. Cat. p. 3, No. 4, 1867.

Hab. Orange Harbor Tierra del Fuego. "Oregon" U. S. Exploring Exp. Smithsonian Cabinet (type) 5963, 17,813 (part).

On examining the apophyses of the type, which opened widely enough for this to be readily done, it was at once evident that this species is a typical *Terebratella.*

With regard to the habitat an error has been perpetuated.

Among the specimens of *W. venosa*, Sol., known to be from Orange Harbor, Patagonia, were two evidently belonging to the genus *Terebratella.*

One of them *was attached by its peduncle* to a specimen of the *Waldheimia.* The other was free. At first, as no other recent species was found to agree with it, it was supposed to be undescribed; but, on comparing it with the (heretofore) unique type of *T. pulvinata*, their identity was at once evident.

The Orange Harbor specimens agreed in every particular, except that the type was a little more dusky in color. The foramen, general form, apophyses and punctate structure were precisely similar. One was a little larger and the other a little smaller than the type.

Dr. Carpenter, in his Report (1863) to the British Association, tabulates it from Puget Sound on the authority of Expl. Ex. and Kennerly. The remark in the text below—"80 fms. living, Cooper, Catalina Ids."—on the authority of Dr. Cooper refers to the *T. californica*, the next following species in the text, and not to *T. pulvinata.* Dr. Kennerly's specimens are not to be found, and I am inclined to believe that they might have been the smooth variety of *caurina*, or worn valves of some other species, perhaps *coreanica.*

At any rate, the only definite locality which we have for this species is Orange Harbor, and it is improbable that the same species occurs in both Patagonia and Oregon. The habitat assigned by Dr. Cooper in his Geog. Cat. of "Puget Sound to Arctic Sea" is gratuitous, as no specimens have been obtained from north of Puget Sound, and, as the foregoing remarks indicate, probably none north of Patagonia.

This species is only distinguishable from young *W. venosa* by the apophyses. I have been unable to detect any constant external differences.

There are no specimens of this species in the collections known to me, in San Francisco; indeed I am only aware of the type and the two other specimens just mentioned.

TEREBRATELLA CAURINA, Gld.—Plate 6, fig. 1, 2, 3.

Terebratula caurina, Gld., Proc. Boston Soc. Nat. Hist. vol. iii, Dec. 1850. Exped. Shells, p. 468, pl. 44, fig. 582.
Terebratella caurina, Gld. (emend), Otia Conch. p. 97, April, 1862. Cpr., Check List W. C. Shells, p. 1. Cpr. Suppl. Rep. Brit. Assoc. p. 636, 1864. Cooper, Geog. Cat. p. 3, No. 8, 1867. Suess, Wohns. i, p. 25, 1859.

Hab. Puget Sound to Sitka. Swan. Dall. Smithsonian Cabinet, 5964 (type), 13,610, 3368, 4177, 4338, 11,785, 11,787.

This species was abundantly obtained at low water mark, adhering to the under surface of large stones and to each other, at Sitka, Alaska Territory. Some young shells, perhaps of this species, were dredged off the peninsula of Aliaska. Puget Sound and Neeah Bay have also furnished specimens.

The very large number of specimens thus obtained afforded an unusually good opportunity for forming a correct idea of the amount of variation possible in a single species. It is a typical *Terebratella*, as the apophyses, which are well preserved in the type, show.

The latter is a small and quite regular specimen, with an ill-defined broad mesial ridge in the neural, and depression in the hæmal, valve.

It has about fourteen subequal radiating ridges, the area broad, hinge line nearly straight, deltidia widely separated, foramen incomplete, large, overshadowed by the sharply pointed apex of the neural valve, which is not truncate and resembles the neural apex of *Rhynchonella*. It is of a grayish ash color, ·6 of an inch wide and ·5 long.

The examination of sixty specimens from Sitka gave the following range of variation:

Greatest width, 1·8 inch. Greatest height, 1·7 inch. Diameter of most inflated specimen, 1·2 inch. The most transverse specimen measured 1·8 inch wide by 1·2 inch long. The most produced specimen measured ·7 inch long by ·4 inch wide. The most compressed specimen was ·35 inch diameter by 1·25 wide and ·75 long.

The colors were usually of a deep crimson mixed with yellow, quite different from the bright color of *T. coreanica*, and *W. Grayi;* but they varied from light ashy yellow to a very dark livid purple, and the epidermis from clay color to blackish brown. The color was sometimes stronger on the lines of growth externally, while the interior was nearly white; while in others the whole substance of the shell was evenly suffused with color, inside and out.

The incomplete foramen appears to be a constant character, though the degree of approximation of the deltidia varies a good deal. The area is almost always strongly marked and nearly smooth. The lines of growth are usually strong and often imbricated, especially when the radiating ribs are strong.

The hinge line is normally nearly straight, and recalls *Spirifer*, but in some adult and many immature specimens is very much arched. The sinuosity of the margin caused by the broad neural mesial ridge is generally present, but varies very much in degree, and is sometimes almost evanescent. When the ribs are strong the margins are crenulated, and *vice versa*. The number of ribs in an adult specimen is from thirty to forty. They vary very much in prominence. Some specimens have none at all; others have half the shell smooth and half ribbed. Some are ribbed only on the umbones; others only near the margin. One specimen, which taken alone would certainly have been considered distinct, is smooth, pink, with a prominent apex, and short, bifurcating, varicose, impressed lines scattered over the surface, a sharp carina on the neural and a corresponding groove on the hæmal valve.

The shell is always thick, solid and strong, even in the smallest specimens. The form presents every possible variation from longitudinally oval to quadrispherically transverse. Many are unsymmetrical, and most of them are overgrown with polyzoa, serpulæ, and corallines. The peduncle is very short and stout.

The apophyses are extremely delicate and fragile, and unusually small in proportion to the shell. The reflected portion of the loop is very short, and the whole of the skeleton is broader in proportion than in any other species known to me. The septum is very small and triangular, it diminishes on each side from the point of attachment of the loop processes and is evanescent in the umbo of the hæmal valve. The most elevated point is midway between the cardinal process and the anterior margin. The cardinal process is inconspicuous. An indication of an obscure mesial ridge may sometimes be seen in the neural valve. The interior of the shell is sometimes a little perlaceous, but it is usually without lustre. The punctures are smaller, more circular and fewer in number than in *T. pulvinata*. An examination of the young shells, only about ·2 in. in extreme width, showed some interesting points.* The septum is calcified very early and is thick, prominent, bifurcate at its extremity, and serrated on its anterior edge. The bifurcation is the first indication of the septal processes which are the last to be calcified, and when the extremely thin hæmal processes are yet incomplete the young shell closely resembles a *Magas*. In the beak of the neural valve just inside the foramen is a very prominent thin lamina or septum which half closes the foramen. In the adult the muscular system is not largely developed. The pedicel muscles are the strongest. The cardinals are slender and their bases are spread over a wide extent of the neural valve, but the muscular impressions are imperceptible. The adductors are small and slender. The brachia follow the lateral loops of the apophyses and cross below the mouth on the reflected portion and the septal processes. There is no central spiral lobe. The fringes are in a single row, flattened and extremely thin; in an adult they are about ·13 in. long. They are much more slender than in *Terebratulina* or *Megerlia*. When fully extended they are far from the margin of the valves. The mouth is circular, situated between the adductors. The visceral part of the system is protected by a thin tough membrane. The color of the animal is reddish or brownish, the ovaria vary in the same way. The perivisceral fluid is of a reddish-yellow color.

---

* From the study of these immature forms I have come to the conclusion that the genus founded by Prof. King on *Terebratula capsula*, Jeff.,

The umbones of both valves are generally eroded by contact with stones. The animal seemed to have the power of turning half around on its peduncle at will.

TEREBRATELLA COREANICA, Ad. and Rve.

Terebratula coreanica, Adams and Reeve, Voy. Lam. 1850, p. 71, pl. xxi, fig. 3. Rve., Conch. Ic. vii, fig. 28, a, b.

Terebratula miniata, Gld., Proc. Boston Soc. Nat. Hist. 1861, p. 323. Suess., Vienna Acad. 1859, p. 206.

Terebratella coreanica, Dav., Ann. Nat. Hist. 1852, p. 367. Schrenck, R. v. Amurl. 1867, p. 468. Rve., Journ. de

cannot be accepted until further information is obtained. The same may be said with regard to *Waltonia* (*Valenciennesii*) Dav. The latter genus has been withdrawn by the author, and the specific name rather hastily applied to the mature form described by the same gentleman (in the P. Z. Soc. 1852, p. 77, pl. xiv, fig. 7–9,) as *Terebratella Evansii*. While it is not impossible that the two are identical, still it would seem unnecessary to reject a name applied to a mature and unmistakable species for one given to a young shell which could hardly be identified without the aid of a very large series of individuals of various ages. The references are as follows:

Gwynia (*capsula* Jeffreys) King, Proc. Dub. Univ. Zool. and Bot. Assoc. Vol. i, 1859, p. 258, fig. 1 to 5. Rve., Conch. Icon. pl. x, fig. 39.

Waltonia (*Valenciennesii*) Dav., An. Nat. Hist. 1850, p. 475. Ib. 1852, p. 372. Gray, B. M. Cat. p. 101. Dav., An. Nat. Hist. 1861, p. 38.

Conchyl. 1861, p. 129. Cpr., Sup. Rep. p. 636, 1864. Coop. Geogr. Cat. 1867, p. 3, No. 7.

Hab. Corea, Belcher, N. Japan Seas, Schrenck. ? Neeah Bay, Swan. Smithsonian Cabinet, ? 15,598.

Dr. Carpenter has marked on the tablet of a worn and broken neural valve "*T. coreanica* var. *frontalis*, Midd.," Neeah Bay, Swan. On comparison with figures, I am disposed to refer the valve, which though worn smooth, still retains some slight traces of striæ; to *W. Grayi*, Dav., which has a very large foramen, while both Reeve and Schrenck figure *coreanica* as with a small complete foramen.

Middendorf's *T. frontalis* is undoubtedly a *Terebratella*, but, assuming the correctness of his figures and descriptions, I can see no reason for uniting *frontalis* with *coreanica*, or indeed with any other species with which I am acquainted. It seems to be remarkably distinct and belongs to a different fauna from *coreanica*. The young state of the latter, according to Schrenck, is of a uniform reddish color (var. *concolor*) while the adult is radiated with red (var. *radiata*); the former is *miniata*, Gld., the latter the typical *coreanica*.

TEREBRATELLA, ———?—Plate 6, fig. 4.

? Terebratella suffusa, Rve., Conch. Ic. pl. v, fig 18. Journ. de Conchyl. 1861, p. 128.

Hab. "*?* Cape of Good Hope, Ex. Ex." Smithsonian Cabinet 5110.

A single specimen, which resembles Reeve's *suffusa* as figured in the Conch. Icon., exists in the Smithsonian Cabinet, and is doubtfully marked as from the Cape. It differs from *suffusa*, as described by Reeve, in wanting the suffusion, being of a light yet rather warm brown; in the deltidia being more widely divided, perhaps because it is an older shell than Reeve's type; and finally in having a flexuous margin and faint depression near the middle of the margin of the hæmal valve. This, however, is not noticeable in the younger portion of the shell.

I am inclined to regard them as identical, and in order that some one, who may be able to examine Reeve's type, can settle the point I add a description and figure of the loop, which Reeve has not described.

The crura are small, slender, short and acute. The loop processes are exceedingly slender, mere threads in fact, and roundly deflected outward at first; bending inward just before the neural bend, they give off two moderately broad septal processes which meet each other at the end of the septum with an angle of 60°

(not at right angles to the septum and behind its end, as in *T. dorsata* or *chilensis*). The main processes are then deflected neurally, and the extreme "bight" of the loop is straight and somewhat angulated at each side. The perforations externally are moderate, arranged in quincunx order, smaller and more regular than in *T. dorsata*, which is its nearest analogue.

The species appear to me to be perfectly distinct from any other described *Terebratella*.

The other recent species are:

Terebratella frontalis, Midd. Malac. Rossica, iii, p. 2. Sib., Reise. Bd. ii, p. 241, pl. xviii, fig. 9, 10, 11, 12, 13 and 14. *Hab.* South coast of the Ochotsk.

Terebratella rubella, Sby., Thes. Con. v, i, p. 350, pl. 69, f. 40, 41, 42. *Hab.* Japan.

Some little confusion attaches to this species on account of its outward similarity to *Waldheimia picta*, Chemn. sp. from Java and *Ismenia sanguinea*, Chemn. sp. (+ *sanguinolenta*, Gm., + *erythroleuca*, Quoy, + *pulchella*, Sby.,) from the Philippines and the Sandwich Islands.

Terebratella Bouchardii, Dav., P. Z. S. 1852, p. 77, pl. xiv, fig. 4 to 6. *Hab.* ? This species somewhat resembles *T. frontalis*, which in Middendorf's figures seems to have lost the deltidia.

Terebratella Labradorensis, Sby., Thes. Conch. vii, p. 362, pl. 71, fig. 89, 90. *Hab.* Coast of Labrador.

Terebratella Mariæ, A. Ad., An. Nat. Hist. 1860, p. 412. *Hab.* Japan.

Subgenus LAQUEUS, Dall.

Shell with the reflected portion of the loop attached by slender processes, on each side, to the hæmal processes, at or near the points where the two septal processes branch off to the septum. Foramen complete.

It will be observed that the reflected part of the loop is attached by the two (lateral) processes, not to the septum nor to the septal processes, but to the hæmal portions of the loop, (which I have termed hæmal processess); thus the two septal processes, the two lateral processes, and the "bight" of the neural loop, form a somewhat sinuous ring, intersected by the point of the septum, the hæmal processes and the two sides of the neural loop.

Type. *Laqueus californicus*, Koch sp. Plate 7, fig. f, pl. 8, fig. 9, 10.

Terebratula californica, Koch, Kuster, Nov. Ed. Martini, viii, pl. 26, fig. 21, 22, 23 (?). Sby., Thes. Conch. vii, 352, pl. lii, fig. 50, 51, 52.

Waldheimia californica, Gray, Brit. Mus. Cat. p. 60, No. 8. Cpr. Sup. Rep. Br. Assoc. p. 568 & 636. Cooper, Geogr. Cat. p. 3, No. 5.

Not *Terebratula californica*, Auct., = *W. venosa*, Sol.

Hab. California. Catalina Island, 80 fms. Cooper. Smithsonian Cabinet, 19,395, Cp. 1093.

Shell oval, thin, inflated, pale at the umbones, elsewhere of a light reddish brown, darker toward the margin; perforations large,, oval, crowded, arranged in quincunx order externally; minute circular, very close together, internally.

Margin straight, without perceptible curve or sinuation, slightly angular at the anterior edge, giving a very slight appearance of truncation. Valves nearly equally inflated. Beak of the neural valve small, recurved, obliquely truncated. Foramen small, entire, apical; the carination of the edge of the false area encroaches on the perforation in a triangular point on each side. False area small, narrow, smooth, roundly carinated at the edge. Deltidia very short and wide, united. Lon., 1·9 in.; lat., 1·6 in.; diameter, 1·2 in.; height of neural apex above the opposite umbo, ·15 in.; diameter of foramen, ·1 in. Peduncle very short and stout. Teeth of the neural valve short and stout. Hinge line very slightly emarginate (for the cardinal process) beneath the umbo, otherwise gently rounded. Teeth supported by shelly plates beneath the hinge line. Cavity of the apex infundibulate. Out of this cavity proceed two strong, but not prominent, ridges, which radiate toward the angles of the anterior edge of the margin, but become evanescent before passing the central third of the shell. Between these ridges are two others, one on each side, close to the median line, shorter and less prominent than the first. There are faint indications of others outside the two first mentioned, and these ridges, except the first two, are variable in different individuals. Cardinal process very inconspicuous. Cardinal plate broadly pentagonal, centrally depressed. Septum not prominent, diminishing in height from the edge of the plate forwards, and not extending more than half the length of the shell; point of attachment of the apophyses quite close to the plate. Apophyses start from the anterior angles of the plate and give off two curved slender crura; the hæmal processes are very slender; septal processes still more so; reflected portion quite broad, somewhat angulated behind, giving off two broad, thin lateral processes, which are attached to the inner edge of the hæmal processes at the point from which the septal processes are extended to the septum. There is no flat top to the latter, such as is seen in *Ter. dorsata*, *effusa* and *caurina.*

This magnificent species was long confounded with *W. venosa.* The septum and characteristic portion of the apophyses were so far back that it was only by separating the valves that the peculiar character of the loop could be certainly determined. It is readily distinguished from *W. venosa* by the want of the prominent cardinal process so evident in that species, different color, the small foramen, and sharply cut cardinal area.

LAQUEUS SUFFUSUS, n. sp.? Plate 7, fig. g, h, s.

?? *Terebratella rubella*, Sby., Thes. v, i, p. 350, pl. 69.

Hab. Wharf at Yokohama, Japan. R. Pumpelly. Smithsonian Cabinet, 11,784.

Shell small, ashy white, with occasionally a tinge of salmon color on the strongest lines of growth, smooth, almost polished; solid and moderately thick; lines of growth moderately conspicuous at intervals, but rounded and hardly interrupting the smoothness of the shell. Punctures smaller, less widely separated, and more circular, on the exterior, than in the last species; internally extremely minute. Lon., ·72 in.; lat., ·52 in.; diam., ·34 in.

The specific characters are best indicated by comparing it with the last species, from the young of which it differs in many particulars, more especially in being very much less transverse, more solid, with a much narrower and longer deltidium, more arched hinge line, and very much stronger and heavier hinge teeth.

Leaving out the question of size, it differs from the adult *californica* in the following particulars: The hinge teeth are more solid, and the plates which support them are usually solid masses of callus, occasionally showing a projecting knob below the teeth, and continuous with the remainder of the shell, instead of having an indentation behind each plate. There are no excavations under the hinge plate as in the last species; the plate is narrower, more excavated above and more solid. The septum falls away behind the point where the septal processes are attached before rising to the hinge plate.

The point of attachment of the septum is much nearer the middle of the shell than in the *californica.* Finally, the apophyses in this species are, proportionately, twice as solid as in the last, which is ten times its size.

Of a dozen or fifteen specimens collected by Prof. Pumpelly, most had the apophyses destroyed by insects, which had eaten the animal matter; but four or five remained perfect, displaying the peculiar loop. But little variation was noticed among them, which consisted principally in the greater or less inflation of the valves, and the absence or presence of the dental laminæ. Some were slightly more transverse than others, but as a whole they were remarkably uniform. The most transverse individual measured ·62 in by ·72 long, and ·225 diameter. The most compressed measured ·50 in. wide by ·70 long, and ·36 diam. A young *californica*, about the same size, measured ·72 long by ·78 wide, and ·55 in. diameter.

Mr. Davidson suggests that this species may be conspecific with *Terebratella rubella*, Sby. I have not been able to make a comparison of specimens, but the form of the two species is very similar. The coloration of *T. rubella*, as figured by Reeve, is very different, however, as is evident from his comparing it to *Wald. picta* and from the figures. None of the specimens of *suffusus* show more than the faintest tinge of salmon color on the stronger lines of growth.

A comparison of types alone can determine the question. They may or may not belong to the same subsection.

It is not improbable that after more careful examination of recent species now referred to *Terebratella* or *Waldheimia*, others may be referred to this subgenus.

Subgenus KINGENA, Dav.

Kingena, Dav., Mon. Cret. Brach. p. 42, 1852.
Ismenia, (part), Gray, B. M. Cat. p. 104 (*Megerlia*).
Megerlea, Dav., Mem. Lin. Soc. de Normandie, 1856, p. 263.
Terebratula, Auct.

Shell as in *Terebratella*, with the posterior part of the reflected portion of the loop broad, angulated, with the two angles bent down on each side and joined to the septum directly (not to the hæmal or septal precesses), forming a broad ring, only intersected by the septum. Exterior granulated, foramen entire.

Type. Kingena lima, Defr. sp., Chenu Man. de Conchyl. ii, p. 205, fig. 1052 (as *M. truncata*). Pl. 8, f. 14.

Terebratula lima, Defr., Dict. Sci. Nat. 1828, vol. 53, p. 156.
Kingena lima, Dav. Mon. Cret. Brach. p. 42, pl. 4, fig. 15 to 28, pl. 5, fig. 1 to 4. Woodw. Man. p. 219, fig. 103.
= *Terebratula pentangulata*, Woodw., + *ventro-plana*, Roem., + *Hebertiana*, D'Orb., + *Spinulosa*, Morris, +*sex-radiata*, J. Sby.

Fossil in the cretaceous strata of England and France.

This subgenus is sufficiently distinct, and forms a natural link between *Laqueus* and *Ismenia*.

Subgenus ISMENIA (King), Gray.

Ismenia, King, Permian Foss. p. 81, 142 (not *Ismenia*, King, Perm. Foss. p. 245, = *Terebratella*).
Ismenia, Gray, B. M. Cat. p. 104. A. Ad. An. Nat. Hist. 1863, p. 99.

Shell externally resembling *Terebratella*. Apophyses broad and short, attached first by the septal processes to a short, stout septum, then recurved, the broad posterior edges of the reflected portion touching and blending with the septal processes and the adjacent part of the hæmal processes, forming a funnel-shaped ring, into which the septum does not project. The lateral loops of the apophyses remain open in the adult.

Brachia without a median spiral lobe.

The name *Ismenia* was originally founded by an error, (see Perm. Foss. p. 245), upon *Terebratulites pectunculus*, Schloth. This error Prof. King corrects, as above, stating that his intended type was *T. pectunculoides*, Schloth. The latter species is only distinguished from the typical *Terebratellæ* by a few calcareous denticles on the anterior terminations of the lateral loops. Now *T. pectunculus* has the loop above described as characteristic of *Ismenia*, as Quenstedt's figure (erroneously referred to by Dr. Gray, in B. M. Cat. p. 95, where the figures of *T. pectunculoides* are referred to, by the numbers which really refer to *T. pectunculus*, which is on the same plate) shows.

Dr. Gray, either intentionally or by mistake, thus retains *pectunculus* as the type in spite of Prof. King's erratum, and the subgenus thus limited will stand properly as of Gray. There can be no doubt as to Prof. King's intentions, as he refers to Davidson's figure of *T. pectunculoides* in the An. Nat. 1850, pl. xv, fig. 5 a, b.

Type *Ismenia pectunculus* (King in err. Per. Fos. p. 81, 142), Gray, B. M. Cat. p. 104 = *Terebratulites pectunculus*, Schlotheim, Quenst. Handb. p. 466, pl. 37, fig. 23, 25.
Fossil, Oxford clay, France; Coral Rag. Germany.

ISMENIA SANGUINEA, Chemn. sp. Pl. 8, fig. 13.

Anomia sanguinea, Chemn., Conch. Cab. viii, p. 96, pl. 78, fig. 706. Dillwyn, Rec. Shells, p. 293, 1817 (not Sol.)
Anomia sanguinolenta, Gmel., S. N. p. 3347.
Anomia cruenta, Sol. MS. in Mus. Banks (not Dillwyn).
Terebratula cruenta, Donovan, Nat. Repos. pl. 56, fig. 1.
Terebratula erythroleuca, Quoy and Gaim. Voy. Astrol. iii, p. 557, pl. 85, fig. 8, 9. Desh. in Lam. ed. ii, vii, p. 350.

Terebratula sanguinea, Sby., Thes. Conch. vii, p. 357, pl. 71, figs. 71–73 (not of Leach, Lam. nor Donovan).
Terebratella sanguinea, Dav., An. Nat. Hist. 1852, p. 368. Gray, B. M. Cat. p. 90. Rve., Con. Ic. pl. vii, fig. 25 a, b, c. Journ. de Conchyl. 1861, p. 128.
Terebratula pulchella, Sby., Thes. Conch. vii, p. 360, pl. 71, fig. 105—107.
Megerlea pulchella, Dav. An. Nat. Hist. 1852, p. 369.
Ismenia pulchella, Gray, B. M. Cat. p. 104.
Ismenia sanguinea, A. Adams, An. Nat. Hist. ii, 1863, p. 99.

Hab. Philippines, Sandwich Islands, Japan. Smithsonian Cabinet, 17,820, 17,821.

This beautiful little species, after having been passed from *Terebratella* to *Megerlia* and back again by various authors, has finally found a resting place in the genus *Ismenia* as restricted by Dr. Gray and Mr. A. Adams.

There is some variation in the obliquity and breadth of the apophyses in different individuals, but the essential characters remain the same.

The punctures in the shell are larger and more conspicuous than in any species of the group with which I am acquainted. The imbricating prisms of which the shelly structure is composed are beautifully conspicuous with a very low power, inside; and even the apophyses seem to exhibit the same or a similar structure, though impunctate.

The colors vary from almost pure white to a livid red marked with brownish streaks. The normal color is white, with a median line of bright red blotches, bounded on each side by a white streak, outside of which the dashes of red radiate toward the margin.

The form is usually somewhat transversely oval, and quite regular. The exterior is usually smooth, almost polished, and very slightly marked with lines of growth. Occasionally, however, they are rough, distorted, and of a rude exterior, resembling *T. rubicunda* junior.

In general, the foramen is moderate and the deltidia are united, but in many cases the foramen is large, the deltidia are more or less widely separated, and the apex is produced.

I cannot doubt the identity of *T. pulchella*, Sby., with *T. sanguinea* of Davidson and Chemnitz.

In the absence of the apophyses this specimen might be confounded with *W. picta* and *T. rubella.*

The only other recent species is *Ismenia Reevei*, A. Ad., An. Nat. Hist. 1863, p. 99. "A large pure white species." Ad. loc. cit. Hab. Gotto, Japan, 48 fathoms.

Genus MEGERLIA, King.*

Megerlia, King, Perm. Foss. 81, 145, 1850. Dav., An. Nat. Hist. 1852, p. 369. Ibid., 1861, p. 38. Woodw., Rec. and Foss. Shells, p. 219. Rve., Conch. Icon. pl. xi. Journ. de Conchyl. 1861, p. 133. Dav., Int. Clas. Brit. Brach. 1851–4, p. 68. H. and A. Adams, Gen. Rec. Moll. ii, p. 578. Jeffreys, Brit. Conch. vol ii, p. 22.

Megerlea, Dav., Intr. a l'Hist. nat. des. Brach. vivent et fossiles Mem. Lin. Soc. de Normandie, 1856, p. 129. Chenu, Man. de Conchyliol. vol. ii, p. 205.

Megathyris, D'Orb. (part), *M. oblita.*

Orthis, Philippi, Moll. Sic. ii, p. 67. Michelotti, Faun. Mio. pl. ii, fig. 21.

Terebratella. D'Orb. An. Sci. Nat. 1848, p. 66 (part).

Anomia, Linn., Pallas, &c.

Terebratula, Auctorum.

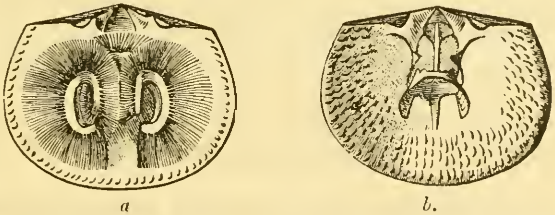
Shell transversely oblong with a straight wide hinge line, distinct area and large incomplete foramen. Externally striate, internally pustulose, somewhat pearly.

Loop resembling that of *Ismenia*, but with the lateral loops filled up with calcareous matter in the adult, forming two spatulate processes.

Brachia behind the mouth, furnished with two lateral lobes and a conspicuous median spiral lobe.

This genus approaches *Ismenia* in the form of the loop, but otherwise is totally unlike that group, which is more properly placed among the *Terebratellæ.*

Fig. 14.



Megerlia truncata, $\frac{3}{1}$ nat. size. *a*, hæmal valve with the animal; *b*, same with animal removed, showing the apophyses.

---

* This is very close to *Megerlea*, Robineau-Desvoidy, Essai sur les Myodaires, 1830, a genus of Diptera. In fact, when properly spelled, they are identical and were named for the same individual. I do not know whether Desvoidy's genus still stands, but in case it does, *Megerlia*, King, will have to be dropped, as the dipterous genus has twenty years' priority.

Note.—A letter from the eminent dipterologist, Baron Osten Sacken, informs me that Desvoidy's genus has not been adopted by entomologists, and therefore we are at liberty to retain the old, familiar and well established name of *Megerlia* for the present genus.

MEGERLIA TRUNCATA, Lin. sp. Fig. 14.

Anomia truncata, Lin., Syst. Nat. 1152. Born., Mus. 118, pl. vi, fig. 14. Chemnitz, Conchyl. Cab. viii, 90, pl. 77, fig. 701. Gmel., S. N. 3343. Dillwyn, Rec. Shells, i, p. 292. Poli, Test. Sicil. p. 191, pl. xxx, fig. 16, 17.

Terebratula truncata, Retz., Nov. Gen. p. 14. Lam., Hist. An. sans Vert. vi, p. 247. Ed. 2, vii, p. 333. Sby., Thes. Conch. vii, p. 354, pl. 71, fig. 64–67. Blainv., Dict. des Sci. Nat. liii, p. 139. Phil., Moll. Sicil. i, p. 95, fig. 12, pl. vi. Quenstedt, Handb. p. 462, p. 37, fig. 10.

Terebratella truncata, D'Orb., Ann. Sci. Nat. 1848, viii, p. 66, pl. vii, fig. 11, 12, 16, 37.

Terebratula monstrosa, Scacchi, Oss. Zool. ii, p. 1.

Anomia disculus, Pallas, Misc. Zool. p. 184, pl. xiv, fig. 1, 1766.

Terebratula disculus, Blainv., Dict. Sci. Nat. liii, p. 138.

Orthis truncata, Phil., Sicil. ii, p. 69.

Terebratula oblita, Mich., Brach. p. 4.

Orthis oblita, Mich., Faun. Mioc. pl. ii, fig. 21.

Megathyris oblita, D'Orb., Prod. iii, p. 134.

Terebratula scobinata, Gmelin, + *T. decussata* de Blainv. + *T. irregularis* de Blainv. fide Rve.

Megerlia truncata, King, Permian Foss. p. 145. Dav., Ann. Nat. Hist. 1852, p. 369. Gray, Brit. Mus. Cat. p. 103, fig. 15, 16. Rve., Conch. Icon, pl. xi, fig. 47 a, b, c. Journ. de Conchyl. 1861, p. 133. Woodw., Man. Rec. and Foss. Shells, p. 219, fig. 122, pl. xv, fig. 9. Chenu, Man. de Conchyl. ii, p. 205, fig. 1053–55 (not 1052 = *Kingena lima*, Dav.) Angas, Austr. Sh. H. and A. Adams, Gen. Rec. Moll. ii, p. 578, pl. cxxxi, fig. 3, 3 a, 3 b, 3 c. Jeffreys, Brit. Conch. p. 22, ii.

Hab. Mediterranean and adjacent shores of the Atlantic. Australia (Angas). Smithsonian Cabinet, 14,560, 14,561, 11,781.

Woodward's figure (122) of this well known species is not very good. In none of the specimens which I have seen does the septum appear so prominently or extend so far beyond the apophyses.

The collection includes a specimen from New South Wales (Coll. Angas), sent under the above name. The shell and apophyses presented no constant difference from Mediterranean specimens. The animal was in a perfect state of preservation in both, and I noticed the following differences, of which only a much larger series would be sufficient to establish the constancy.

The central spiral lobe of the brachia, prominent in the European species, seemed to be nearly wanting in the Australian shell. The fringes in the former were nearly twice as long, the individual filaments much more slender, and five or six times as numerous as in the latter.

The range thus indicated is extraordinary, and much more remarkable than the discovery of Indo-Pacific species in Japan by Arthur Adams; still the recent deep sea dredgings by English and American naturalists overturn many of our former notions in regard to the distribution of marine animals, and we may expect to find the range of low forms, such as the Brachiopoda, greatly increased by further researches.

Genus MAGAS, Sby.

Magas, Sby., Min. Con. vol. ii, p. 39, 1818. Dav., Int. Br. Brach. p. 70, 1851. Mon. Cret. Brach. p. 19. Ann. Nat. Hist. 1852, p. 371. D'Orb., Pal. Fran. Ter. Cret. 1847, iv, p. 54. Gray, B. M. Cat. 1853, p. 98. Woodw., Rec. and Foss. shells, p. 217. H. and A. Adams, Gen. Rec. Moll. ii, p. 577. Chenu, Man. de Conchyl. ii, p. 207. Rve., Conch. Icon. pl. 8. Journ. de Conchyl. 1861, p. 130, King, Perm. Foss. p. 81.

Orthis sp. De Koninck (not Dalman).

Rhynchora, Dalman, 1827 (*R. spathulata*) part.

Shell with a prominent septum in the hæmal valve, to which the hæmal processes of the loop are attached by their sides before being reflected.

(In *Terebratella* the hæmal processes are attached to the septum by septal processes; in the present genus no septal processes intervene, but the attachment is of the hæmal processes themselves directly to the septum by their inner edges.)

Type Magas pumila, Sby.

Subgenus MAGAS.

Reflected portion of the loop incomplete in the adult.

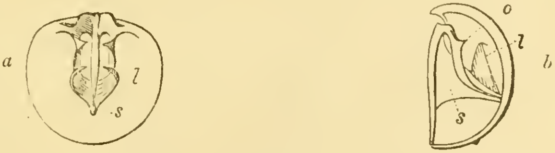


Fig 15.

Fig. 15 a, b. *Magas Pumila*, $\frac{2}{1}$ nat. size. *o*, crura; *l*, incomplete loop; *s*, septum.

Type. *Magas pumila*, Sby., fig. 15 a, b.

Magas pumila, Sby., Min. Conch. ii, p. 40, pl. 119, fig. 1 to 5, 1818. Bouchard and Dav., Bull. Soc. Geol. de France 2nd. ser. v, p. 139, pl. ii, fig. 1 to 11. Dav., An. Nat. Hist. v, pl. xv, fig. 2. Quenst., Handb. p. 476, pl. xxxviii, fig. 15.

Magas truncata, Rose, in Woodw. Geol. Norfolk, pl. 6, fig. 9.

Magas magna, } Woodw., Synopt. Tab. p. 22, fide Gray.
Magas punctata, }

Terebratula concava, Lam. An. s. Vert. vi, p. 251, No. 26, (1819). Dav., An. Nat. Hist. v, 1850, June. Deshayes, Lam. Ed. 2d, vii, No. 26.

Terebratula magas, Blainv., Man. Mal. p. 512, pl. 54, fig. 1 (1825).

Terebratula pumila, v. Buch., Mém. Soc. Géol. de France, iii, 1st series, p. 216, pl. 19, fig. 5.

Magas pumila, Gray, B. M. Cat. p. 99, fig. 9, 10. Woodw., Rec. and Foss. sh. p. 217, fig. 117. Chenu, Man. de Conchyl. ii, p. 207, fig. 1059, 1060. King, Permian Foss. p. 81.

Hab. Fossil in the cretaceous beds of Europe.

In this, the type of the genus, the hæmal valve is almost flat and the neural valve inflated and nearly touched by the apex of the septum. The beak of the neural valve is strongly recurved, with a minute foramen and rudimentary deltidium. The cardinal process is prominent and the area of the neural valve is well defined. Although only found in a fossil state, many of the specimens retain radiating colored bands.

MAGAS DAVIDSONI, De Kon.

Rhynchora Davidsoni, De Koninck, fide Dav. An. Nat. Hist. 1855, p. 434, pl. x, fig. 4, 4a.

Hab. Fossil in the cretaceous beds of Mæstricht.

This species is said by Mr. Davidson to be similar to one of Dalman's types (*R. spathulata*) and the examination of the internal structure by M. Bosquet, during his work on the cretaceous Brachiopoda of Maestricht, shows that it is a typical *Magas*. The apophyses exactly resemble those of *M. pumila*, while the hinge margin is much broader than in that species, and nearly straight. The other type of *Rhynchora* was *Waldheimia? pectinata*, Linn., according to Woodward and Dr. Gray. This disposes of a genus badly characterized and founded on an error, which has been the cause of much difficulty and confusion. (See Woodw. Man. Rec. and Foss. Shells, p. 217, note).

? MAGAS PATAGONICA, Gould. Pl. 6, fig. 11, 12.

Terebratula patagonica, Gld., Proc. Boston Soc. Nat. Hist. Dec. 1850. Otia Conch. p. 97. Ex. Exp. shells pl. 44, fig. 583, 583e.

Waldheimia patagonica, Gld., Otia Conch. Rect. p. 246, Index p. 256.

Terebratulina ? patagonica, Suess, Wohns. der Brach. ii, p. 16.

Hab. Patagonia, Orange Harbor, U. S. Ex. Exp. Smithsonian Cabinet, 5965 (type). Mus. Comp. Zool.

This species (which must not be confounded with the fossil *Waldheimia patagonica*, Sby., Darwin's S. Am. p. 252, pl. ii, fig. 26, 27, 1846, and Gray, B. M. Cat. p. 60), was originally referred by Dr. Gould to *Terebratula*, and, in his rectification, to *Waldheimia ;* it seems to be a true *Magas*, and among a lot of small specimens referred by Mr. Reeve to *Terebratella dorsata* (juv). I found a number of specimens, although the type was supposed to be unique. In the type specimen the apophyses are broken off, but the septum remains intact.

The shell is of a waxen white color, fan-shaped, moderately oval or transverse, ornamented with rounded divaricating ribs or plications which are evanescent at the apices of the valves and strongest at the margin. It is generally compressed, though a moderate degree of inflation exists in a few individuals. The neural valve is most inflated and has a prominent beak slightly recurved and pointed at the apex, beneath which is a large horse-shoe-shaped foramen, with parallel sides and widely separated deltidia. The latter are narrow and long, divided by an impressed line from the false area, which is short and very wide. The hæmal valve is provided with an inconspicuous but acute apex, and small, moderately wide cardinal process. The teeth and sockets are moderately strong and the former are not supported by laminæ. The punctures are very prominent, both inside and outside, and almost visible to the naked eye. They are quite circular. The hinge plate is wide and excavated in the middle, or rather there is no transverse lamina before the cardinal process and between the sockets. Instead, two thin laminæ are placed between the under sides of the sockets, extending obliquely inward for a short distance, and attached to the cavity of the apex, forming a triangular ridge in the median line, from which the septum takes its rise. The latter is broad and biangulate at its neural extremity. Two hæmal processes, provided with short pointed crura, proceed from the sockets and are attached, about midway between the valve and the apex of the septum, to the latter. From the posterior apical angle of the latter two broad, roundly-recurved processes are extended posteriorly. The anterior apical angle of the septum is extended a short distance in front of them and is somewhat before the anterior point of its base. The muscles are stout and well developed; the neural insertion of the cardinals is about the middle of the valve. The margin is sometimes slightly flexuous. The measurements of three specimens are ·44, ·48 and ·24 in. long; ·5, ·52 and ·32 wide; by ·16, ·21 and ·09 in. in diameter. The apex of the neural valve is ·09 in. above the apex of the hæmal valve in the largest specimen, and the width of the foramen is ·05 inches.

This is the first described recent species, belonging to the true type of *Magas*, with the reflected processes disunited, and does not appear to have been noticed by European authors* under any name. Since the opinion might be advanced that the reflected processes had been broken apart, I would state that I have examined specimens still containing the brachia, and the complete disunited ends of the processes might be readily seen with a glass through the translucent animal matter. The brachia appeared to be a simple loop without lateral lobes or central spiral lobe. It is still possible, however, that in older specimens the loop may be completed, bringing the species into the next section.

Subgenus MAGASELLA, Dall.

Shell with the reflected portions of the apophyses united, forming a loop.

This comprises most of the recent species of *Magas*.

Fig. 16.

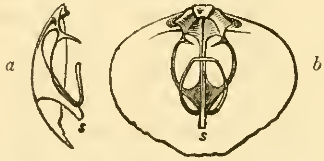


Fig. 16 a, b. *Magasella Evansii*, Dav., hæmal valve and profile; *s*, septum.

Type. *Magasella Evansii*, Dav., fig. 16 a, b.

Terebratella Evansii, Dav., Proc. Zool. Soc. 1852, p. 77, pl. xiv, fig. 7—9. An. Nat. Hist. 1852, p. 368, n. 26. Woodw., Rec. and Foss. sh. p. 217, fig. 116.

Magas Evansii, Gray, B. M. Cat. p. 99, fig. 11 and 12.

Magas Valenciennesii, Rve., Conch. Icon. pl. viii, fig. 31, a, b, c. Journ. de Conchyl. 1861, p. 130.

---

* Except Suess, l. c.

Hab. New Zealand. Coll. Cuming.

This species has been referred to recently by Messrs. Davidson and Reeve, as the adult of *Waltonia Valenciennesii*, Dav., an immature? brachiopod previously described. For reasons elsewhere stated I have thought it best to retain the original name until more is known.

MAGASELLA FLEXUOSA.

" *T. magellanica*, var.," Reeve, MSS. label.
? *Terebratula flexuosa*, King, Zool. Journ. vol. v, p. 337. Sby., Thes. Conch. vii, p. 347, pl. 69, fig. 23, 24.
? *Terebratella flexuosa*, Gray, B. M. Cat. p. 87. Dav., An. Nat. Hist. 1861, p. 38. H. and A. Ad., Gen. Rec. Moll. ii, p. 576.
Terebratella Magellanica, Reeve, Conch. Icon. pl. ? fig. ? Journ. de Conchyl. 1861, p. 127.

Hab. Straits of Magellan, Orange Harbor, Ex. Exp. Smithsonian Cabinet, 11783.

I am not sure this is King's species as I have not had access to the Thesaurus, but it is certainly not a *Terebratella*, though it resembles *T. dorsata* externally.

Shell dull reddish brown, solid, transversely ovate; neural valve strongly bicarinate, emarginate, provided with about 28 strong, sharp, divaricate, radiating ribs or plications somewhat imbricated by the lines of growth. Margin of the valves strongly flexuose. Neural valve somewhat arched by the carinæ, otherwise the shell is moderately compressed. The beak is short and wide, false area smooth, except for lines of growth, and carinated at the edges; wide and narrow; deltidia long, narrow and slightly separated. Apex slightly recurved, foramen circular, incomplete. Apex of hæmal valve flattened, nucleus acute but inconspicuous. Cardinal process prominent, bifid, excavated at its extremity; hinge plate moderate, excavated, centrally grooved and laterally bicarinate; from the carinations spring the apophyses. Beneath the hinge plate there are two cavities, one on each side of the septum, extending into the beak. The mesial ridge, deeply grooved above, extends from the septum under the hinge plate to the middle of the shell, when the true septum rises abruptly. It is slender, angulated and extending obliquely forward meets the hæmal processes, which give off a triangular web of shelly matter to its upper edge. Leaving the hinge plate at the terminations of the lateral carinations, two short, slender, pointed crura are curved inward, and the hæmal processes curve roundly, to meet the septum as before described.

They are of the most extreme tenuity. The apex of the septum is a small, triangular knob, from which a large thin loop is directed posteriorly. In the specimen this is not quite perfect, but the loop when perfect is evidently entire.

The interior of the neural valve is broadly sulcate on each side of a faint mesial ridge, the sulcations corresponding to the carinæ. The muscular impressions are close in near the cavity of the beak. There is a sharp ridge or septum just inside of the foramen from one side of it to the other.

The punctures are very large, circular, and under the glass recall the cells of Polyzoa. The margin of the valves is sharply crenulated from the extremities of the external plications.

The nearest ally of this species is *Magasella Evansii*, from which it is readily distinguished by its form, color, foramen, sharp plicæ, form of the septum and other minor details. It best agrees with the description of King's species.

Length 1·04 in., breadth 1·03 in., diameter ·52 in.

MAGASELLA (? var.) LÆVIS, Dall. Pl. vi, fig. 9, 10, 13.

? Terebratula Malvinæ, D'Orb., Voy. Am. Merid. v, p. 674, No. 779, ix, pl. 85, f. 27, 29.

Hab. Orange Harb., Patagonia. Smithsonian Cabinet, 11,782.

Shell perfectly smooth except for the light, but beautifully regular, rounded, concentric lines of growth. Outline nearly circular, beak somewhat produced, slightly recurved, with a large incomplete horse-shoe-shaped foramen. The false area sharply carinate and separated from the deltidia by a deep groove. The deltidia are short, moderately wide and widely separated. Shell not inflated, of a horn color, and conspicuously punctate. Margin of the valves straight, without any indentation or flexure. Teeth and sockets slender and weak, the whole texture of the shell being exceedingly delicate and papyraceous.

The cardinal process is hardly perceptible. The hinge plate is very thin, excavated, and covers the posterior end of the mesial ridge which divides the cavity of the beak below the hinge plate into two parts. The crura are very short and delicate, the hæmal processes at first slender, rapidly widen, throwing off a triangular lamina of shelly matter from the inner sides which reaches the septum and become consolidated with it between the anterior and posterior edges, so that the posterior edge of the septum forms a wall between the two triangular laminæ. In the last species the edge does not project above the lozenge-shaped plate formed by the two laminæ, and in *? Magas patagonica* there is only a rounded ridge between them. The septum is broad, arising close to the hinge plate, obliquely forward, and is truncate at its extremity, which touches the opposite valve. The reflected loop is broad and quite circular. The cardinal muscles are attached in the apical cavity of the neural valve. The peduncle is short and stout, the other muscles are very slender.

Length ·34 in., breadth ·32 in., diameter ·16 in.

A single specimen was found adhering by its peduncle to a large specimen of *Waldheimia venosa* from Orange Harbor, Patagonia. ? "Les isles Malouines," D'Orb., l. c.

It is not unlike, in general appearance, a very minute specimen of *W. venosa*, except that the foramen is much larger, incomplete and of a different shape. It may be identical with D'Orbigny's species, of which the apophyses are not figured, but differs in its small size and rounded form.

The other species of the genus are as follows:

Magasella Spitzbergensis, Davidson, P. Z. S. 1852, p. 78. Rve. Conch. Ic. pl. vii, fig. 24.

Some specimens marked " *T. Labradorensis*," in the Museum of the Philadelphia Academy, but agreeing with Reeve's figure and descriptions, have the typical loop of *Magasella*.

Hab. North Atlantic and Arctic seas, Murray Bay; Gulf of St. Lawrence, P. P. Cpr.

Magasella Cumingii, Davidson, P. Z. S. 1852, p. 78, pl. xiv, fig. 10—16. Reeve, Conch. Ic. pl. viii, f. 29.

Habitat. New Zealand.

Magasella crenulata, Sby., Thes. Conch. i, p. 358, 1846, pl. 71, fig. 96—98.

This species resembles *? Magas patagonica*, Gld., and they may prove identical upon comparison.

Habitat. "Santa Cruz, Canaries, Cuming," *teste* Rve., apparently with doubt.

Section KRAUSSININÆ.

Loop entirely absent, apophysary system consisting of two lamellæ attached to the prominent mesial septum of the hæmal valve, and laterally extended.

The external characters of the two genera which compose this section, differ widely; but we have seen that these external attributes are of little value, even in the same genus, in many cases, and hence the evident relations of the apophyses will outweigh the former in determining the arrangement of the genera. Even in this manner far less violence is done than if we regarded them both as sub-genera of a single heterogeneous group.

Genus KRAUSSINA, Dav.

Kraussina, Dav., An. Nat. Hist., 1861, p. 39. Bronn. Malacozoa, iii, part i, pp. 304, 306, 309. Martens Zool. Rec., 1864, et seq.
Kraussia, Dav., An. Nat. Hist. ix, p. 369, 1852. Woodw. R. and Fos. Shells, p. 219. Dav. Int. Brit. Brach. p. 69. H. and A. Adams, Gen. Rec. Moll. ii, 578. Gray, B. M. Cat. p. 109. Rve., Conch. Icon. pl. ix. Journ. de Conchyl. 1861, p. 131. Dav., An. Nat. Hist. vol. 16, p. 430, 1855. Chenu. Man. de Conchyl. vol. ii, p. 206. Nom. preöc. teste Davidson.
Terebratula, (*capensis*), Krauss., Sud-Afr. Moll. 1848.

Shell with a straight hinge line, truncated beak and large incomplete foramen. Both valves possessing a more or less marked false area. The umbo of the neural valve is separated from the foramen by a more or less prominent septum. Shell structure conspicuously punctate. In the hæmal valve a mesial ridge extends from the apex to the centre of the shell: at its anterior extremity it is projected upwards, forming a stout process bearing two lateral processes, which are somewhat angulated, sometimes bifid, and are extended toward the margin of the valve anteriorly. The brachia are very small, the central spiral lobe minute, and the mouth is situated behind the brachia. Pedicel muscles leaving a strong impression on the hinge line of the hæmal valve.

Fig. 17.

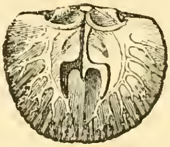


Fig. 17. *Kraussina rubra*, hæmal valve. $\frac{2}{1}$.

Type. *Kraussina rubra*, Pallas, fig. 17.

Kraussina rubra, Dav., An. N. H. 1861, p. 39.
Anomia rubra, Pall., 1766, Misc. Zool. pl. xiv, fig. 2, 11.
Anomia striata, Chemn. viii, p. 94, pl. 77, fig. 703.
Anomia capensis, Gmel., S. N. p. 3347. Dillw., Rec. Sh. i, p. 292.

Terebratula rubra, Blainv., Dict. Sci. Nat. liii, p. 138. Sby., Thes. Conch. vii, pl. 68, fig. 10.

Terebratula capensis, Krauss, Sub. Afr. Moll. p. 32, pl. ii, fig. 10. (Not of Ad. and Rve.,) Voy. Sam. p. 71, pl. xxi, fig. 4.

Kraussia rubra, Dav., An. Nat. Hist. 1852, p. 370. Gray, B. M. Cat. p. 109, (fig. 19, not 20). H. and A. Adams, Gen. Rec. Moll. ii, p. 579. Rve., Conch. Icon. pl. ix, fig. 37, a, b, c. Journ. de Conchyl. 1861, p. 131. Chenu, Man. de Conchyl. vol. ii, p. 206. fig. 1056, 1058.

Terebratula rotundata, Blainv., fide Reeve.

Hab. Cape of Good Hope, "Orange Harb.," U. S. Ex. Ex. Smithsonian cabinet, 17817.

The attachments of the pedical muscles in this species are very large and strongly impressed. The septum or mesial ridge is rather faint. The cardinal process is moderate. The terminations of the apophysary arms are somewhat spatulate. The form is frequently distorted and very variable. The neural valve is usually the most inflated. The apical septum is most evident in small specimens, becoming eroded in very large or old specimens. The foramen extends behind the carination of the area. The teeth are not supported by laminæ. The mantle adheres closely to the shell at the margin, and the muscles are very stout and strong. The ovaria are widely ramified. Setæ were not observed in the mantle-edge of dried specimens.

Fig. 18.

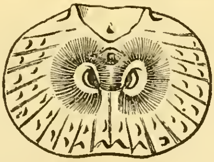


Fig. 18. *Kraussina Lamarckiana*, hæmal valve with animal.

KRAUSSINA LAMARCKIANA, Dav., fig. 18.

Kraussia Lamarckiana, Dav., An. Nat. Hist. 1852, p. 370. Proc. Zool. Soc. 1852, p. 80, pl. xiv, fig. 22, 23. Gray, B. M. Cat. p. 111, fig. 20? H. and A. Adams, Gen. Rec. Moll. ii, p. 579. Chenu, Man. de Conchyl. ii, p. 206, fig. 1057.

Kraussina Lamarckiana, Dav., An. N. Hist. 1861, p. 39.

Hab. Sidney, Australia. Newcomb.

This pretty little species is very poorly represented by Gray's figure, which gives a very erroneous idea of the hinge line. Chenu's figure is better, but the cardinal process is too prominent, and the area below the hinge line quite incorrect. The cardinal process is hardly perceptible at all, the septum is prominent and grooved on the upper edge. The apophysary processes are broad and folded together, having a sulcate or bifid appearance; the interior edges are approximated and the exterior edges are somewhat produced into a rounded point. On opening a dried specimen I could detect no central spiral lobe; this may have been owing to the condition of the individual. The interior of the shell is prettily marked with eight or ten radiating rows of tubercles on each side, and is very conspicuously punctate. The transverse ridge or septum, in the apex of the neural valve, is well marked in my specimens. The neural valve is emarginate anteriorly, and the margin of both valves is consequently somewhat flexuous. The pedicel muscular scars are minute, but perceptible. The other species of this genus are:

Kraussina cognata, Chemn., Dav. An. Nat. Hist. 1852, p. 370.

Hab. South Africa.

Kraussina pisum, Lam., (Val.) Hist. Nat. An. s. Vert. 2d ed. vii, p. 330, = *Terebratula natalensis*, Krauss.

Hab. South Africa.

Kraussina capensis, Ad. and Rve., Zool. Samarang, p. 71, pl. 21, fig. 4. = *Kraussia Deshayesii*, Dav.

Hab. Cape of Good Hope.

This species was named *capensis* by Ad. and Rve. The name was admissible, as Gmelin's *capensis* is a synonym of *rubra*, Pallas. It was afterward described by Mr. Davidson as *K. Deshayesii*, which name, for the above reasons, must stand as a synonym. The species is, very probably, identical with *Kraussina rubra*, and I doubt if *Kraussina pisum* and *K. cognata* are not also different ages of one species. The denticulated margin mentioned by Reeve as peculiar to *cognata* is probably an individual peculiarity, and similar to the marginal tubercles in old and thickened specimens of *Megerlia truncata*.

? *Kraussina picta*, Val., Verh. Zool. Bot. Ges. Wien, 1865, p. 894.

Hab. St. Paul Island, Indian Ocean.

Genus BOUCHARDIA, Dav.

Terebratula, Blainv., Dict. Sci. Nat. liii, p. 145, 1828.

Bouchardia, Dav., Bull. Soc. Géol. de France, vol. vii, 1849, p. 62, pl. i.; An. Nat. Hist. 1852, p. 372. King, Perm. Foss. p. 81, 1850. Gray, B. M. Cat. p. 100. H. and A. Adams, Gen. Rec. Moll. ii, p. 557. Chenu, Man. de Conchyl. ii, p. 207. Woodw., Rec. and Foss. Shells, p. 218. Rve., Conch. Icon. pl. viii; Journ. de Conchyl. 1861, p. 130. Dav., Int. Brit. Brach. p. 70; An. Nat. Hist. 1861, p. 38.

Shell with a nearly straight beak, apically foraminated with a small circular perforation. No true area or deltidium. Hinge-plate large, solid, provided with Λ-shaped diverging ridges, probably for the attachment of the cardinal muscles. Socket ridges of the hæmal valve largely developed, and fitting into corresponding furrows in the neural valve. There is no cavity beneath the hinge-plate; from its base a not prominent median septum arises, reaching beyond the middle of the shell, and bearing two pointed, lateral, posteriorly recurved processes. Muscular scars in the neural valve, subcentral and divided by a mesial ridge.

Fig. 19.

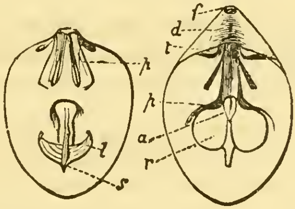


Fig. 19. *Bouchardia tulipa*, interior of both valves. *f*, foramen; *d*, deltidium; *t*, dental sockets; *r*, cardinal scars; *a*, adductor scars; *p*, peduncular muscle scars; *s*, septum; *l*, lateral processes of septum.

Type. *Bouchardia tulipa*, Blainv., fig. 19.

Terebratula tulipa, Blainv., Dict. Sci. Nat. liii, p. 144, 1828.

Terebratula rosea, Mawe, Int. to Conch. 1823? Sby., Gen. fig. 4; Thes. Conch. vii, p. 357, pl. lxxi, figs. 74, 75, 76, 77. Deshayes, in Lam. 2nd. Ed. Hist. des An. s. Vert. vii, p. 350. King, An. and Mag. Nat. Hist. 1846, pp. 34, 38.

T. unguis, Kuster, Conchyl. Cab. vii, p. 35, fig. 8—10, 1842.

Pachyrhynchus roseus, King, Perm. Foss. p. 70.

Bouchardia rosea, Dav., Bull. Soc. Géol. de France, vol. vii, p. 62, pl. i, figs. 1 to 6. King, Perm. Foss. p. 81.

Bouchardia tulipa, Dav., 1851, Int. Brit. Brach. p. 70, figs. 17, 18, pl. vi, figs. 22—25. Woodw., Rec. and Foss. Sh. p. 218, fig. 118. Gray, B. M. Cat. p. 101, figs. 13, 14.

Rve., Conch. Icon. pl. viii, fig. 33; Journ. de Conchyl. 1861, p. 130. H. and A. Adams, Gen. Rec. Moll. p. 577, pl. 131, figs. 2, 2a. Chenu, Man. de Conchyl. ii, p. 208, figs. 1061—1063.

? *Bouchardia fibula*, Rve., Conch. Icon. vii, fig. 30 a, b.

Hab. Rio Janeiro, 13 fathoms, McGillivray.

This very remarkable shell is well distinguished from the last genus in the form of the neural umbo, the cardinal process and hinge-plate, and the apophyses, which principally differ from *Kraussina* in being posteriorly instead of anteriorly directed. The figure given by Woodward and Gray gives a poor idea of it. A much better one may be found in Davidson's introduction to the classification of the Brachiopoda, plate vi. The area where the deltidium should be is flat or excavated.

The other species, referred by Reeve to this genus, does not belong to it.

The genus is only known in a recent state.

Section PLATIDIINÆ.

Shell with the loop attached, not reflected; animal with sigmoid brachia meeting behind the mouth, without any spiral median lobe or lateral loops. Cardinal process absent.

Genus PLATIDIA, Costa.

Platidia, O. G. Costa, Fauno del Reg. Napoli, Jan. 1852, p. 47.

Morrisia, Dav., An. Nat. Hist. May, 1852, p. 371. Woodw., Rec. and Foss. Shells, p. 218. Rve., Conch. Icon. pl. x; Journ. de Conchyl. 1861, p. 134. Dav., An. Nat. 1861, p. 39. Bronn, Malac. iii, pt. i, pp. 304, 306, 309. Chenu, Man. de Conchyl. p. 208. H. and A. Adams, Gen. Rec. Moll. ii, p. 579.

Shell with a large foramen encroaching upon both valves, ventral valve with a small straight area, deltidia absent or rudimentary, valves articulated by teeth and sockets, structure coarsely punctate. Apophysary system reduced to two short arms provided with crura, proceeding from the hinge margin and attached to a small central septum.

In the last section the hæmal processes were absent and the neural portion of the loop, in a modified form, present. In this section the reverse is the case.

Fig. 21.

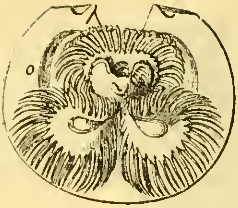


Fig. 20.

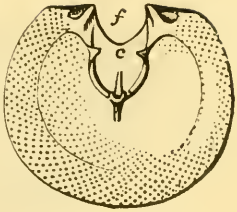


Fig. 20. *Platidia anomioides*, hæmal valve with animal. $\frac{10}{1}$.
Fig. 21. Same. *f*, pedicel notch; *c*, apophyses; *o*, ovaries.

Type. *Platidia anomioides*, Scacchi, sp., fig. 20, 21.

Terebratula anomioides, Scacchi, Phil. Moll. Sicil. ii, p. 69, pl. xviii, fig. 9 (1844).

This species is equal to *appressa*, Forbes, + *seminulum*, Dav. (not *T. seminulum*, Phil.), and possibly + *eusticta*, Phil. (?)

Hab. Mediterranean, living, 95 fathoms, and fossil (*eusticta*) in the pliocene of Palermo.

If the last mentioned species is really synonymous with *P. anomioides*, as some authors have suggested, the former name will have to take precedence, as it was published in 1836.

The other recent species of *Platidia* are:

Platidia lunifera, Phil., 1836, Moll. Sicil. i, p. 97, pl. vi, fig. 16.

Platidia Davidsoni, Deslongchamps, An. Nat. Hist. 1855, xvi, p. 443, pl. x, fig. 20, a, b, c, d.

Both of the above species are found in the Mediterranean.

?Platidia gigantea, Desh., Maillard, Moll. Isl. Bourbon, 1864.

Hab. Isle de Bourbon, S. Ocean.

Section MEGATHYRINÆ.

Argiopidæ, King, Perm. Foss. p. 142.

Shell with a straight, wide hinge-line; apophyses consisting of a submarginal loop, attached at the hinge margin and provided with crura, intersected by one or more submarginal elevations or septa.

Brachia submarginal, surrounding a smooth disk or membrane, in the middle of which the mouth is situated. Pedunculated.

Fig. 22.

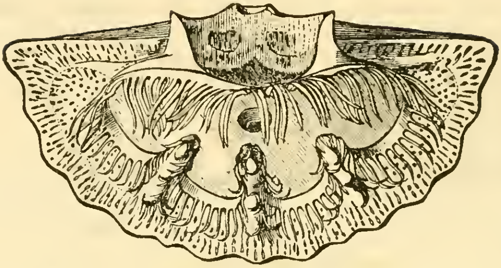


Fig. 22. *Megathyris decollata*, $\frac{40}{1}$, hæmal valve and animal.

Genus MEGATHYRIS, D'Orb.

Mantle adherent to the shell. Foramen and area large.

Subgenus Megathyris, D'Orb.

Megathyris, D'Orb., Pal. Fran. Ter. Cret. 1847, p. 147. Prod. ii, p. 259. An. Sci. Nat. 1848.

Argiope, Desl., 1842 (not Savigny), Mém. Linn. Soc. Normandie vol. vii, p. 9; Bull. Soc. Géol. Fran. vii, 2nd Series, p. 65. Dav., Int. Class. Brit. Brach. p. 72; Mem. Lin. Soc. Normand. vol. x, 1856, p. 137; P. Z. S. 1852, p. 81; An. Nat. Hist. 1852, p. 372, 1861, p. 39. Rve., Conch. Icon. pl. x; Journ. de Conchyl. 1861, p. 135. Woodw., Rec. and Foss. Shells, p. 220. Chenu, Man. de Conchyl. ii, p. 209. H. and A. Adams, Gen. Rec. Moll. ii, p. 580. Bronn, Malac. iii, pt. i, pp. 304, 306, 309.

Orthis, sp. Phil., Hagen. Mich., not Dalman.

Terebratula, Lam., Blainville, &c. (sp.)

Anomia, Chemn., Gmel., Muhlf., &c. (sp.)

Shell transversely oblong, or semicircular; smooth or ribbed with more or less prominent radiations; strongly punctate; hinge-line wide; area flat; foramen large, triangular or rounded; deltidium absent or rudimentary; interior of hæmal valve furnished with from three to five, or more, rounded submarginal septa, over which the broad loop is bent and attached. The brachia are continuous and follow the course of the loop, and hence appear four-lobed. The cardinal process is large and strong, centrally excavated. The interior of the shell is pustulose.

The name *Argiope* was proposed in 1827 by Savigny and Audouin (Descr. de l'Egypt, ed. ii, xxii, p. 334, pl. ii, fig. 6), for a genus of Egyptian spiders, typified by *Aranea lobata*, Pall.

(*A. sericea*, S. and A.) This genus was properly characterized, and is still in use. It has fifteen years' precedence over *Argiope*, Desl., which necessarily becomes a synonym of the next regularly proposed generic name applied to this group. This is *Megathyris* of D'Orbigny, 1847, which must therefore be adopted. For information in regard to Savigny's genus, see Thorell, Ann. and Mag. Nat. Hist. 1868, p. 190.

Fig. 23.

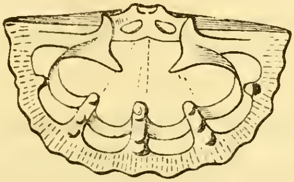


Fig. 23. *Megathyris decollata*, $\frac{4}{1}$, showing the apophyses.

Type. Megathyris decollata, Chemn., sp. fig. 22, 23.
Anomia decollata, Chemn., Con. Cab. viii, p. 96, pl. 78, fig. 705.

This is *Anomia detruncata*, Gmel., + *Terebratula decollata*, Desh., + *T. aperta*, Blainv., + *T. dimidiata*, Scacchi, + *T. cardita*, Risso, + *T. urna-antiqua*, Risso, + *Argiope decollata* of Dav., Rve., and most modern authors.

As Chemnitz was not a binomial writer, it is probable that his specific name ought to give place to that of Gmelin.

Hab. Mediterranean, living; fossil in the miocene of Gibraltar and pliocene of Calabria.

Subgenus CISTELLA, Gray.

Cistella, Gray, B. M. Cat. Jan. 1853, p. 114. H. and A. Adams, Gen. Rec. Moll. ii, p. 581 (not *Cistelia*, Geoffr. and Fabr. Coleop.)
Zellania, Moore, Proc. Somerset Archæol. and Nat. Hist. Soc. 1854. Dav., Mem. Lin. Soc. Normandie 1856, p. 141, pl. vii (type, *Z. Davidsoni*, Moore, figs. 43, 44). Chenu, Man. de Conchyl. ii, p. 210.

Shell with a single median submarginal septum and bilobed loop. Surface smooth, or radiately ribbed. Brachia interrupted by the septum.

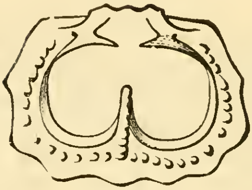


fig. 24.

Fig. 24. *Cistella neapolitana*, $\frac{8}{1}$, hæmal valve and apophyses.

Type. *Cistella cuneata*, Risso, sp.
Terabratula cuneata, Risso, Eur. Merid. 1826, fig. 179.

Hab. Mediterranean, living.

This is the *Terebratula detruncata*, Scacchi (not Gmelin), + *T. soldaniana*, Risso, Blainv., + *Anomia pera*, Muhlf., + *Orthis pera*, Phil., + *Argiope cuneata* of most modern authors.

The remaining recent species of *Cistella* are:

Cistella Neapolitana, Scacchi, sp., Oss. Zool. 1833, ii, p. 18. Dav., Ann. and Mag. Nat. Hist. 1861, p. 40.

Hab. Mediterranean, living and fossil in the pliocene of Tarentum.

This is the *T. seminulum*, Phil. (not Dav.), *T. lunifera*, Sby. (not Phil.), and the *Argiope Forbesii*, Dav.

Cistella cistellula, S. Wood, sp., An. Nat. Hist. 1840, 5. Dav., Ann. and Mag. Nat. Hist. 1861, p. 40.

Hab. Zetland, and the north-west coast of Europe.

Cistella Barrettiana, Dav., P. Z. S. 1866 (Feb.), p. 103, pl. xii, figs. 3, 3a, b, c.

Hab. North-east coast of Jamaica, 140 fms.

? *Cistella antillarum*, Crosse and Fischer, Journ. de Conchyl. (March) 1866, p. 270, pl. viii, fig. 7, two views.

Hab. Guadeloupe, W. I., 125 fms.

This is perhaps identical with the preceding species.

Cistella Woodwardiana, Dav., P. Z. S. (Feb.) 1866, p. 103, pl. xii, figs. 4, 4a, b, c.

Hab. North-east coast of Jamaica, 60 fms.

Cistella Schrammi, Crosse and Fischer, Journ. de Conchyl. (March) 1866, p. 269, pl. viii, figs. 6, 6.

Hab. Guadeloupe, W. I., 125 fms.

This species would seem, from the figures of Messrs. Davidson and Crosse, to be quite distinct from *C. Woodwardiana*, yet it is possible that one of them may inadequately represent the shell, and the two prove identical. In this case, Mr. Davidson's name has a few weeks' priority.

It is singular that the descriptions of these last mentioned species should have been first published, almost at the same moment, by different authors, especially as new species of *Megathyris* are by no means common.

? Family THECIDIIDÆ.

Thecidæ, Desh., En. M. iii, 1836.

Shell (perforate when young ?) attached by the neural valve when adult.

Brachia lobed, not spiral, shell articulated by teeth, sockets, and a cardinal process.

Disk grooved or excavated for the reception of the brachial lobes. Mantle adherent, extending to the margin of the valves; the brachia folded upon themselves and supported by a complicated calcareous network secreted by the mantle. Loop absent, except the crura, which usually are united behind the mouth, forming an arch over the viscera; but are occasionally blended with the surrounding calcareous matter.

Soft parts with the mantle united behind. Sexes separated. Female provided with a nidamental sac, in which the embryos are incubated, after passing out of the perivisceral cavity through the oviduct, and becoming attached to two specially modified brachial filaments, the ends of which are inserted in the marsupium. Intestine cæcal. Mantle margin without setæ. Embryos transversely segmented, covered with vibratile cilia, provided with two or four ocular spots on the anterior segment, and strongly resembling the embryonic *Pneumodermon*. Adults sensible to the light. Perivisceral fluid colorless.

Genus THECIDIUM (Defr.), Sby.

Thecidea, Defr., 1828, in Fer. Tab. Syst. p. 38.

Thecideum, Lacaze-Duthiers, Ann. Sci. Nat. Zool., T. xv, 1861, p. 262.

Thecidium, Sby. (emend.), Gen. Shells 1844, xx.

Thecidium, Dav., Int. Brit. Brach. p. 77; Mém. Lin. Soc. de Normandie 1856, p. 145. Suess, Ibid. p. 45. Deslongch., Ibid. p. 61, and most modern authors.

Shell thick, punctate, rounded or oval, more or less regular. Neural valve somewhat produced and perforated by a minute apical foramen, usually closed at an early age. Hinge area flat, triangular; deltidium triangular, hardly distinguishable from the area; interior deeply concave, furnished with two prominent cardinal teeth. Brachia often irregular, separated by a median ridge from which other ridges branch out, often unsymmetrically. In the excavations between these ridges the brachia are placed like a fringe upon the mantle.

Hæmal valve furnished with a prominent cardinal process between the sockets, and this process is frequently broadly channelled. Just before it is the cavity for the viscera, which is often overshadowed by the calcareous network which supports the mantle.

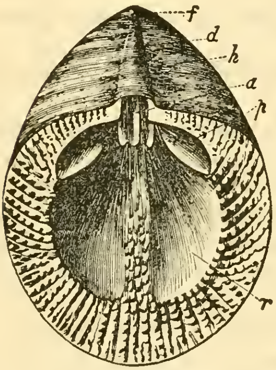


Fig. 25.

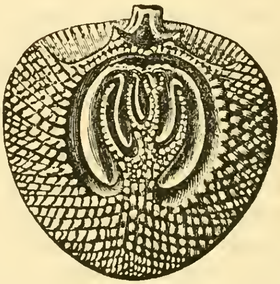


Fig. 26.

Fig. 25. *Thecidium radians*, neural valve: *f*, rudimentary foramen; *d*, deltidium; *h*, hinge area; *a*, cavity for adductor; *p*, dental sockets. $\frac{4}{1}$ nat. size. Fig. 26. Hæmal valve of the same. $\frac{4}{1}$ nat size.

Type. Thecidium pumilum, Val., apud Lam. sp. 1819; Hist. Nat. p. 58. Dav., An. Nat. Hist. 1850, pl. xiv, fig. 58. =*Thecidea radiata*, Defr., Fer. Tab. Syst. 38, 1821, + *T. papillata*, Bronn.

Fossil, cretaceous beds of Europe.

After a careful study of the admirable plates of M. Deslongchamps, with the paper of M. Suess which accompanies them, as well as of the observations on the genus by Messrs. Davidson, Deslongchamps and others, I am compelled to dissent entirely from the views of those naturalists in regard to the homologies of the internal calcareous network which is so remarkable in *Thecidium*.

I can see no grounds for considering this network as equivalent to the loop of *Megathyris* or any other genus of the *Terebra-*

tulidæ. The only portion of the internal structure of *Thecidium* which seems clearly homologous with any part of the loop of *Megathyris*, is the "bridge," so called, which, it may be supposed, is equivalent to the crura of the last-named genus, united and thickened. The loop of the *Terebratulidæ* appears to me to be entirely absent, while the brachia are supported in a totally different manner in the present group.

Instead of the brachia being supported by a calcareous loop of constant shape and (relative) size, as in all the genera of the *Terebratulidæ*, they appear in *Thecidium* to be more or less intimately attached to the mantle itself. This part of the mollusk is well known to be extremely variable in its form and extent. In some genera, such as *Terebratella*, we find the edge of the mantle varying in form during different stages of the same individual, as is evident by the smooth surface, radiating ribs or concentric striæ which mark different parts of the surface of the same shell. In some, we find that the mantle has been unsymmetrical, one side being more developed than the other, while in other specimens again we find more or less development of some portion of the margin, while other portions are abnormally retarded in their growth. These cases are marked by excessive lateral or mesial extension of the shell, with corresponding compression of the mesial or lateral margins.

The mantle consists in the *Brachiopoda* of two laminæ, the one adhering to the shell and apophyses, and the other forming a coat for the arms and adhering to the former. The two lobes corresponding to the two valves are united only at the base of the peduncle, where they form the visceral cavity.

M. Eudes-Deslongchamps, in an extremely interesting paper (Mem. Lin. Soc. de Normandie, 1864), has described the calcareous spiculæ which exist in the mantle of all the genera of *Terebratulidæ*, and shown to what an extent they are produced in old individuals. Now, I believe that the mantle of *Thecidium*, in the absence of apophyses such as serve for its support in other genera, is upheld by an extraordinary deposition of such spiculæ, in the form of a network more or less consolidated, which varies in form with the variations of the mantle, often unsymmetrical on the two sides of the same individual.

That this calcareous deposit is not homologous with the loops of other genera, is shown by the fact that in those genera the spiculæ exist, in greater or less amount, independently of the loop, which is constant in its form, while in *Thecidium*, which has no loop, although the general form of the soft parts much resembles the same parts in *Megathyris*, they are deposited by the variable lobes of the mantle, and serve as its only support. Both the neural and hæmal lobes secrete those deposits, which in old specimens, as shown by M. Deslongchamps, often obliterate the mesial ridge and form a solid bed of calcareous matter. Now the loop of other genera is only found upon the hæmal valve, it does not increase in (relative) size with age, nor become abnormally calcified or thickened.

Again, we find no submarginal loop in the neural valve of other genera, with which the submarginal calcareous deposits which exist in the neural valve of some species of *Thecidium* can be homologized. (See Davidson, Mem. Lin. Soc. de Norm. p. 153, pl. viii, fig. 15, *T. vermiculare*).

These facts show that no true homology exists between the two formations. Mr. Davidson (in Mem. Lin. Soc. de Norm.) in his classification of the *Brachiopoda*, hints at this view of the matter, which has been made clear by the further researches of M. Deslongchamps. The resemblance between the lobed structure of *T. digitata* and the loops of *Megathyris decollata*, is due to a similar form of the soft mantle edge in both, and by no means justifies the deductions of M. Suess in his paper on the internal structure of the *Thecidiæ*.

The spiculæ are frequently deposited upon the hinge margin and crura, which has led to further misconception, and induced the belief of the identity of the two dissimilar structures.

I would add that I consider the gap between this section and the others as far wider than between any two other sections of the group, and that no sufficient reasons have yet been adduced for uniting the family *Thecidiidæ* with the *Terebratulidæ*. Nevertheless, for the present, I would defer to the opinions of the learned naturalists previously mentioned. I think sufficient information has hardly been brought forward to justify the opinion of Lacaze-Duthiers that *Thecidium* in its young state is not pedunculate. Judging by analogy, it certainly should be; and if it is not, it would almost be a sufficient reason of itself for separating the group as a separate family.

M. Suess divides the group into five lesser groups, typified respectively by *T. hippocrepis*, Goldf., *T. papillata*, Schloth., *T. digitata*, Sby., in the cretaceous beds; *T. triangularis*, D'Orb., and *T. sinuata*, Desl., from the Great Oolite and Liassic strata.

M. Deslongchamps proposes an arrangement of six groups, typified by *T. Perieri*, E. Desl., *T. mayalis*, E. Desl., *T. sinuata*, E. Desl., *T. triangularis*, D'Orb., *T. papillata*, Schloth., and *T. digitata*, Sby.

In the present state of our knowledge of the subject I am not convinced that any of these groups are sufficiently well marked to constitute subgenera. The only recent species of *Thecidium* are:

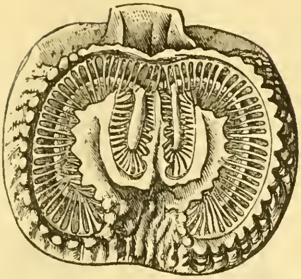


Fig. 27.

Fig. 27. *Thecidium mediterraneum*, hæmal valve with the animal, four times the natural size. From a specimen in the collection of Thos. Davidson, Esq.

Thecidium Mediterraneum, Sby., Thes. Conch. vii, p. 371, pl. 73, fig. 30–32. Lacaze-Duth., loc. cit., p. 262, pl. i—iv.

This species is found attached to corals in the Mediterranean. It is the *T. testudinaria*, Michel., and the *T. spondylea*, Scacchi. It has also been found in Jamaica.

Thecidium Barretti, Woodw., Geol. Mag. 1864, i, pl. ii, fig. 1—3. Dav., P. Z. S. 1866, p. 104.

This species, first described from fossils, has been found living on the coast of Jamaica, at 60 fathoms.

Family *RHYNCHONELLIDÆ.*

Genus RHYNCHONELLA, Fischer.

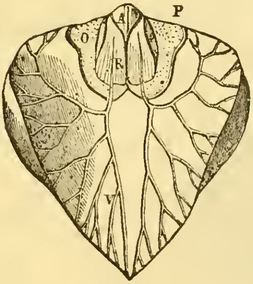


Fig. 28.

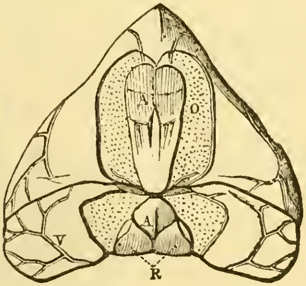


Fig. 29.

Fig. 28. Neural aspect of *Rhynchonella acuminata*, fossil, from a cast, showing vascular impressions.

Fig. 29. Umbonal aspect of the same. A, adductor scar; R, cardinal; P. pedicel; V, vascular; O, ovarian impressions.

Rhynchonella, Fischer, Not. des Fos. du Gouv. de Mosc. 1809.

Type. *Rhynchonella loxia*, Fischer, Dav. Int. Brit. Brach. pl. vii, fig. 99—107.

It is very desirable that the structure of the crura in this species should be examined, as it is very probable that it may prove quite different from that of the recent species now generally known by the name of *Rhynchonella.*

The recent species of this genus are :

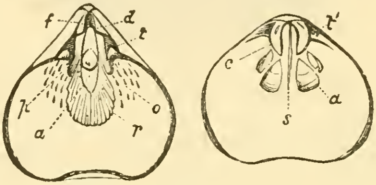


Fig. 30.

Fig. 30. Interior of valves of *Rhynchonella psittacea ;* *s*, septum ; *f*, foramen : *d*, deltidium ; *t*, teeth ; *t′*, sockets ; *c*, oral lamellæ; *a*, adductor scars ; *r*, cardinal do. ; *p*, pedicel do. ; *o*, ovarian spaces.

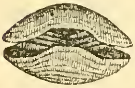


Fig. 31.

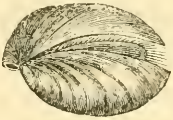


Fig. 32.

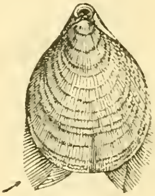


Fig. 33.

Figs. 31—33. *Rhynchonella psittacea*, living, after Barrett. The arms appear never to be exerted any further beyond the shell.

Rhynchonella psittacea, Gmelin, Rve. Conch. Icon. pl. i, fig. 2 a, b, c.

Hab. Boreal and Arctic Seas.

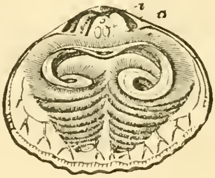


Fig. 34.

Fig. 34. *Rhynchonella nigricans*, Sby. ; *a*, adductors ; *i*, cæcal end of intestine

Rhynchonella nigricans, Sby., Thes. Conch. i, p. 342, pl. 71, fig. 81, 82.

Hab. New Zealand and adjacent seas.

Rhynchonella Grayi, Woodw., An. and Mag. Nat. Hist. 1855, p. 444, pl. x, fig. 16 a, b, c.

Hab. Feejee Islands.

Rhynchonella Woodwardii, A. Adams, An. and Mag. Nat. Hist. 1863, p. 100, No. 2.

Hab. Rifunsiri, 35 fms.; Gotto, 48 fms.; Japan.

Rhynchonella lucida, Gld., Proc. Bost. Soc. Nat. Hist. 1860, p. 323. Otia Conch. p. 121.

Hab. Japan coast, 110 fathoms.

The above list is given for the convenience of students.

Family *LINGULIDÆ.*

Synopsis of Characters.

LINGULIDÆ.—Shell pedunculate, peduncle passing between the valves; inarticulate, subequivalve containing phosphate of lime. Brachia lateral, subspiral, symmetrical without apophyses.

LINGULINÆ.—Posterior-adductor scar, median, single. Shell more or less elongate.

Lingula.—Elongate; anteriorly expanded, posteriorly tapering; smooth or striated; thin; with a thin epidermis. Substance of the valves impunctate, traversed by excessively minute tubuli. Beaks simple; neural beak more produced. No internal laminæ or apophyses, except a more or less pronounced mesial ridge.

Glottidia.—Shell with two diverging internal laminæ in the neural valve proceeding from the beak, and a mesial septum in the hæmal valve. Otherwise essentially as in Lingula?

Lingulella.—Shell with the neural beak produced and grooved for the passage of the pedicel; rounded triangular.

* Trimerella.—Shell with a longitudinal septum supporting a flat lozenge-shaped plate, serving as a muscular fulcrum, and attached to the valve by its lateral edges.

* ? Gotlandia.—Valves distinctly articulated by grooves in

the hinge plate, and a prominent cardinal process fitting into a semilunar pit below the neural area. Each valve bearing a tubular process on each side of the septum.

---

* These two forms somewhat resemble *Obolus* in shape; their muscular impressions are not known, but perhaps they may eventually be placed in the second division of the family.

LINGULEPIS.—Visceral area neurally tripartite, hæmally flabelliform; post. occl. scars within the visceral area; ant. add. in its anterior sinuses, ant. occl. median.

OBOLINÆ.—Post adductor scars double, more or less separated from the median line. Shell more or less orbicular.

OBOLUS.—Shell orbicular; neural beak short; hinge margin flat; cardinal border grooved for the pedicels. Hæmal beak inconspicuous, valve more or less flattened. Ant. add. scars ovate, converging anteriorly.

OBOLELLA.—Shell with minute area usually grooved. Ant. add. scars diverging anteriorly.

Kutorgina.—Hinge line straight, meeting the lateral margins at an angle. Neural valve with an area and foramen. Shell Orthisiniform.

Monobolina.—Shell like Obolus, muscular impressions united along the median line.

? SPONDYLOBUS.—Shell suborbicular. Hæmal apex excentric. Valve with a thickened base interiorly. Neural valve with a marginal apex, channelled, and with a thickened hinge line on each side of the groove. Shell structure testaceous, not glossy, fibrous.

Family LINGULIDÆ, King.

Lingulidæ, Dav., Int. Br. Brach. p. 133.

Shell furnished with a peduncle passing between the apices of the valves; inarticulated, subequivalve, composed of horny laminæ alternating with cretaceous layers; containing phosphate of lime; impunctate. Brachia unsupported by calcified processes.

Section LINGULINÆ.

Genus LINGULA, Brug.

Lingula, Brug., Ency. Meth. tab. 250, 1789.
Pharetra, Mus. Bolt. Ed. ii, p. 111, 1819.

Shell thin, subequivalve, equilateral, tapering at the beaks, expanded at the pallial region. Valves held together by the adductor and pedicel muscles. Beak of the neural valve slightly more produced and pointed than the other. Surface smooth or concentrically striated, covered with a thin epidermis. Brachia elongated, subspiral, situated on each side of the mouth, externally ciliated. The muscular impressions are light; close to the beak is one formed by the post adductor, two others (*adductores anteriores*) are seen near the middle of the shell; they are divided in the neural valve by a blunt projection, and in the hæmal valve by a mesial ridge. In the neural valve another triangular depression just before the last mentioned, indicates the seat of the insertion of the anterior retractors.

Horny laminæ of the shell permeated by excessively minute tubuli.

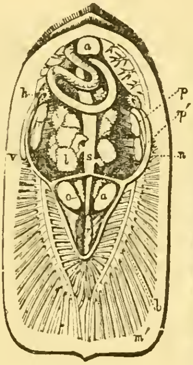


Fig. 35.

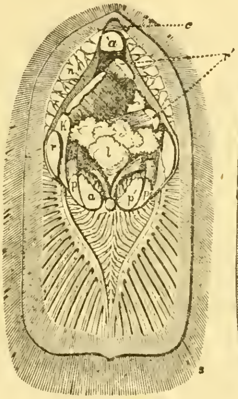


Fig. 36.

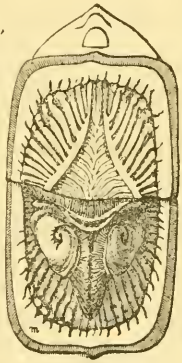


Fig. 37.

Fig. 35. Hæmal view of animal of *Lingula anatina*, after Woodward.

Figs. 36, 37. Neural views of same. *aa*, anterior adductors; *a′*, post adductor; *pp*, external protractors; *p′p′*, central protractors; *c*, capsule of pedicel; *nn*, visceral sheath; *o*, œsophagus; *s*, stomach; *l*, liver; *i*, intestine; *v*, vent; *m*, mantle-margin; *s*, setæ; *b*, pallial sinuses and their branches.

Type. *Lingula anatina*, Lam., Anim. sans Vert. vol. vii, p. 390.

Hab. Moluccas and Philippines.

The peduncle of *Lingula* is not a simple means of attachment alone as in the *cirrhipedes*, but is mobile and muscular; the animal when detached from its position is able to move it rapidly about, like an arm or fin, and, when attached, by using its support as a fulcrum it can move the shell in various directions with great facility. They prefer sandy or muddy bottoms, into which they would appear to be able to burrow with their peduncle, and remain with only the anterior edge of the valves at the surface of the sand. They are frequently entirely unattached.

The Paleozoic *Lingulæ* may have belonged to the same genus as the recent forms, but it is very probable that many, if not all of them, did not; as we find granulated, radiately striated and otherwise ornamented forms, which differ entirely in this respect from the living *Lingulæ*, the outline of many of the older species also being rounded triangular, and some of them were provided in the neural valve with a sharp elevated mesial septum; these features do not characterize the recent species. The other recent species of *Lingula* are as follows:

Lingula ovalis, Rve., P. Z. S. 1841, p. 100.

Hab. Sandwich Islands.

Lingula tumidula, Rve., P. Z. S. 1841, p. 100.

Hab. Moreton Bay, Australia. Japan.

This species, judging from the figure in the Conch. Iconica, differs materially from the other species there figured, in the broad form, emargination of the beaks and the size and position of the muscular impressions. A variety (?) *compressa* is found in the Philippines.

? Lingula Murphiana, King, Rve., Conch. Icon. pl. i, fig. 3, 1861.

Hab. Moreton Bay, Australia.

This species (?) much resembles *L. anatina.*

Lingula hirundo, Rve., Conch. Icon. pl. ii, fig. 7, 1861.

Hab. Port Curtis, North-east Australia.

Lingula exusta, Rve., Conch. Icon. pl. ii, fig. 9, 1861.

Hab. Moreton Bay, Australia.

Lingula hians, Swains, Zool. Ill. vol. ii, pl. ii.

Hab. China Seas.

Lingula smaragdina, A. Ad., An. and Mag. Nat. Hist. 1863, p. 101.

Hab. Yobuko, Japan.

Lingula jaspidea, A. Ad., An. and Mag. Nat. Hist. 1863, p. 101.

Hab. Mososeki, Japan.

Lingula lepidula, A. Ad., An. and Mag. Nat. Hist. 1863. p. 101.

Hab. Seto Uchi, Japan.

Genus GLOTTIDIA, Dall.

Shell linguiform, elongate, pedunculated; general characters as in *Lingula.* Neural valve provided internally with two sharp narrow incurved laminæ, diverging from the beak and extending about one third the length of the shell; anterior extremities of the laminæ about midway between the mesial line and the margin. Hæmal valve with a mesial septum of about the same length extending forward from the beak. Anterior adductor impressions rounded, separated by a faint mesial ridge, faintly impressed. Scar of the post adductor close in the cavity of the beak, rounded. No other evident scars. Shell smooth, perforate or imperforate.

Type. Glottidia albida, Dall. Pl. 8, fig. 1—6.

? Lingula albida, Hinds, Voy. Sulphur. p. 71, pl. 19, fig. 4. Rve., Conch. Icon. pl. i, fig. 4.

Hab. San Diego, Cooper. Santa Barbara, 28 fms., Newcomb. Smithsonian Cabinet, No. 19,416.

Shell creamy white. Smooth and polished except for faint lines of growth, outside. Inside whitish toward the centre, yellowish toward the edge; extreme margin brownish horn color. Interior with faint wrinkles, caused, perhaps, by drying; longitudinally faintly striate at the anterior margin. Mesial ridge very faint, prolonged in a white line upon the yellowish part of the shell near the anterior margin. Laminæ sharp, elevated, with their upper edges inclined inward, not blended in the beak cavity, but continued, closely parallel, to the apex. They probably serve as fulcra for the post parietal muscles. They terminate abruptly, not fading off gradually. Externally, toward the anterior margin, there is a faint mesial ridge which terminates in a small point on the anterior edge of the shell. Peduncle stout, transversely wrinkled, exhibiting two longitudinal ridges with a deep groove between them. Length in the dried specimen about an inch. Neural valve ·94 in. long by ·48 in. wide at the broadest part. Distance between the extremities of the laminæ ·26 in. Height of the latter above the shell ·02 in.

A single neural valve with the peduncle attached and a fragment of the hæmal valve was recovered from some alcoholic miscellanea received from Dr. Cooper, as dredged by him in San Diego Bay, California. The fragments were returned by Mr. Cuming as *Lingula albida*, Hds., and it is not improbably that species.

The specimen differs from the figure in the Conchologia Iconica, in being more compressed at the sides, and in wanting the oblique transverse striations of the figure.

I am informed that Dr. W. Newcomb dredged a living specimen of this species off Santa Barbara Island, California, and that it is now, with the remainder of his fine collection, in the cabinet of Cornell University, New York.

This species differs from the typical species of *Lingulidæ*, in the diverging lamellæ which support the post-parietals, in the form of the anterior adductor scars, and in its color.

A microscopical examination of the shell gave the following results:

There were no punctures visible with a good light and a power of 900 diameters. The substance of the shell was shown by a cross section to be composed of translucent horny laminæ, nearly parallel with one another and separated by layers of white amorphous calcareous matter which looked much like powdered sugar. There were no tubuli visible after the most careful search; the horny layers presented faint indications of a partially fibrous structure, but nothing of the kind extended to the calcareous layers. A section of the lamina much resembled the end of a T-rail, with one flange taken off and obliquely inclined. The anterior part of the shell contained less calcareous matter than that nearer the beaks, and the margin seemed entirely horny. The number of horny layers amounted to eight or ten, in the thickest part of the shell. They were not uniform in thickness, but were thinner than the amorphous calcareous layers.

The paucity of material prevented a fuller examination, but it is to be hoped that some one will examine typical specimens of Hinds' species and report on their structure. The present species may be distinct and the *albida* a true *Lingula*, but this can only be decided by reference to the type.

If the two are identical, it seems strange that the remarkable internal structure should have remained so long unnoticed.

This genus appears to take the place in America of the genus *Lingula*, which has its home in the Australian and Indo-Pacific Seas.

GLOTTIDIA PYRAMIDATA, Stm.

Lingula pyramidata, Stm., Am. Journ. Sci. and Art, 1860, xxxix, p. 444.

This second species of *Glottidia* is generally of small size and horny texture. There is a very slight deposit of lime in the thickest part of the shell, but the greater portion is nearly or quite destitute of it, and contracts irregularly in drying. The laminæ and septum are entirely horny. The shell structure appeared finely perforate under a power of 100 diameters. The septum and laminæ are about one-third as long as the shell.

This species has so far been found unattached. It is extremely active in its motions when disturbed, and has the power, as described by Mr. Morse, of burrowing in and travelling over the sand by contortions of the peduncle and movements of the setæ. Furthermore, the soft parts secrete a mucus to which grains of sand adhere, forming a "sandtube" of an extremely ephemeral nature, which sometimes extends over part of the valves; resembling in appearance, but not in texture or solidity, the tubes of some Sabellarian worms. For further details the reader is referred to the forthcoming memoir of Mr. Morse.

It is found on the south-eastern coasts of the United States, from Newberne to Port Royal.

? ? GLOTTIDIA SEMEN, Brod.

Lingula semen, Broderip, P. Z. S. 1833, p. 125.

Habitat.—Isle of La Plata, West Columbia.

It is possible that this and the following species also, from their outward resemblance to the two preceding, may belong to the present genus.

? ? GLOTTIDIA ANTILLARUM, Rve., Conch. Icon. pl. ii, fig. 8, 1861.

Hab.—Martinique, Cuming.

? ? GLOTTIDIA AUDEBARTI, Brod., P. Z. S. 1833, p. 135. Rve., Conch. Icon. pl. i, fig. 5.

Hab.—Isle de Puna, Bay of Guayaquil; Cuming.

Genus LINGULELLA, Salt.

Lingulella, Salt, Mem. Geol. Surv. of Great Britain, vol. iii, p. 333, 1866.

Shell resembling *Lingula*, with a produced neural beak, grooved for the passage of a very narrow pedicel. General form rounded triangular. Visceral area of the interior of the shell more or less strongly pitted.

Type. Lingulella Davisii, McCoy, An. and Mag. Nat. Hist. viii, p. 405. Dav., Sil. Brach. p. 55, pl. iv, fig. 1 to 16.

This is the oldest form of *Lingulidæ* known, according to Mr. Davidson. It is from the lower Silurian formation.

Genus TRIMERELLA, Bill.

Trimerella, Bill., June, 1862, Pal. Fos. Geol. Sur. of Canada, vol. i, p. 166.

Shell ovate, moderately convex, solid, and transversely striated. The inner surface of each valve furnished with a longitudinal septum, supporting a flat, horizontal, lozenge-shaped plate, attached by its posterior edges to the inner surface of the valves upon which the muscular apparatus was attached. On each side small ovate muscular scars, as in *Obolus*. Hæmal hinge line with faint longitudinal ridges.

Type. *Trimerella grandis*, Bill., Pal. Foss. Geol. Surv. Can. p. 166, fig. 151 a, b, 1862.

Fossil in the Silurian beds of Canada.

GOTLANDIA, Nom. gen. prov.

Trimerella, Lindström, Ofv. K. Vetenskaps Ak. För. 1867, p. 253, pl. xxi. Not *Trimerella*, Billings.

Shell subelongate, rounded before ; neural valve with an acute, produced apex ; hæmal shorter and more rounded, provided with a projecting, semi-oval, cardinal process, which is articulated into a half-moon-shaped pit just before the area in the neural valve ; hinge line of the latter very long and deeply grooved, the two grooves meeting at an acute angle on the posterior end of the valve. The hinge line of the hæmal valve is simple, fitting into the grooves just described, forming with the cardinal process an articulation of the two valves. Neural septum rounded at its anterior end, extending nearly to the margin ; on each side of the septum and closely attached to it is a tubular process extending as far back as the hinge margin, where the base forms the concave anterior wall of the cardinal pit. The top of the septum is lower than the concave surfaces of the tubes and forms the bottom of a gutter between them. The anterior ends of the tubes are nearly in the middle of the valves. Similar tubes exist in the hæmal valve, and the perforations are shown by a section to extend nearly to the apices. They are represented in casts by conical slender processes. The area behind the cardinal pit is covered with callus in the form of arched lamellæ. The muscular impressions have not been clearly made out, but appear to have been situated on the upper, posterior ends of the tubes.

Loc.—Silurian beds of the island of Götland.

This genus, as will be seen by the diagnoses, is quite distinct from *Trimerella*, Billings, though the latter has faint ridges on the cardinal border, recalling to some extent the teeth of this form; though from the examination of the casts of *Trimerella* in the cabinet of Prof. James Hall, and gutta percha moulds prepared from them by Mr. Whitfield, it is evident that they have few characters in common with the one now under consideration. As Dr. Lindström did not give his species any name, and I am unable to find any other reference to it, I would propose the provisional name of *Gotlandia Lindströmi.*

This genus was unknown before the publication of Lindström's paper, and it proves to be extremely interesting. Here is a shell whose nearest affinities are with *Lingula* and *Obolus*, which, nevertheless, is as distinctly articulated as *Terebratula* itself! This raises the query as to the comparative value of the characters used by Gray, *i. e.*, the spiral or non spiral brachia, with those used by most naturalists in separating the Brachiopoda into orders. The muscular impressions would seem to have been remarkably posterior and the tubes may have been the seat of the ovaria.

Genus LINGULEPIS, Hall.

Lingulepis, Hall, 16th Regents Rep. 1863, p. 129.

Shell linguloid, inequivalve, equilateral, oval-ovate or spatulate; in the neural valve the visceral area is tripartite, the lateral extensions the larger; in the hæmal valve the area is flabelliform. Shell corneous, phosphatic.

The scars of the anterior adductors appear to be in the sinuses on each side of the median prolongation of the visceral area in the neural valve. The posterior occlusers are very small, and placed within the visceral area much as in Lingula, except that they are close together, and located further back. The anterior occlusors median; before the mesial point of the area?

Type. *L. pinnæformis*, Hall, 16th Regent's Rep. pl. vi, fig. 15, 16. Owen, Geol. Minn. and Wisc. p. 582, pl. I. B. fig. 3, 4, 8.

Fossil in the Silurian formation.

This form is closely related to *Lingula*; the visceral area is slightly thickened, so that it leaves an indentation on internal casts. These have been referred to as muscular impressions.

Section OBOLINÆ.

Post adductor scars more or less separated from the median line.

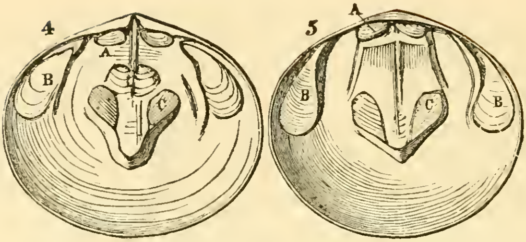


Fig. 38.

Fig 38. *Obolus Davidsoni*, Salter; after Davidson. 4, neural valve; the central scar is that of the pedicel muscles. 5, hæmal valve. A, post-adductors. B, sliding muscles. C, anterior adductors.

Genus OBOLUS, Eichw.

Obolus, Eichwald, Zool. Spic. vol. i, p. 274, 1829?
Ungula, Pander, Beiträge zur Geog. Russ. Reich. 1830.
Ungulites, Pander, Herman. ii, p. 132.
Aulonotreta, Kutorga, Ueb. die Siph. Verh. K. min. Ges. für 1847.

Shell subequivalve, orbicular, non-articulated valves united to each other by the muscles.

Neural valve most convex, with a short beak, flat hinge margin and false area, over which the lines of growth pass without interruption. The cardinal border is longitudinally grooved for the passage of a peduncle. Hæmal valve shorter than the other, slightly convex or quite flat, without a prominent apex. The hinge line passes, in a rounded arch, insensibly into the lateral margin; the cardinal border is flat, thickened and transversely striated, but not sulcated. Structure calcareo-corneous. External surface smooth or concentrically wrinkled. The neural valve is marked by a mesial ridge extending half its length; four small oval muscular scars are situated, one on each side, near the cardinal angles (*retractores posteriores*), the other two near the apex, on each side of the mesial ridge (*adductores posteriores*), and the scars of the anterior adductors are somewhat elongate, with their pointed terminations converging anteriorly in the middle of the valve.

Type. *Obolus apollinis*, Sch., Dav. Int. Br. Brach. p. 136, pl. ix, fig. 280—84.

Fossil in the Silurian beds of Russia.

Genus OBOLELLA, Billings. Pl. 6, fig. 7.

Obolella, Bill., Pal. Fos. Can. Geol. Surv. vol. i, 1861, p. 7.

Shell ovate or subquadrate, convex or compressed. Neural valve with a more or less minute false area, usually grooved for the passage of the peduncle. Hæmal valve with or without an area. Lateral scars near the margin of the cardinal border; scars of anterior adductors differing from those of *Obolus* in diverging instead of converging anteriorly.

Type. *Obolella chromatica*, Bill., Pal. Fos. Can. Geol. Survey, vol. i, 1861, p. 7, fig. 7 a, b, c, d.

Subgenus KUTORGINA, Bill.

Kutorgina, Bill., Pal. Foss. Can. Geol. Survey, 1861, p. 69.

Hinge line straight, nearly as wide as the shell, sides nearly straight, meeting the cardinal border at an obtuse angle.

Neural valve with an area and foramen. A pair of subcentral, oval muscular impressions, but no vestiges of lateral scars. Externally radiately striate.

Type. *Obolella* (*Kutorgina*) *cingulata*, Bill., Pal. Foss. Can. Geol. Sur. p. 9, fig. 8, 9, 10.

This subgenus differs from the typical form by its straight hinge line and striations, as well as the absence of the lateral scars; it resembles an *Orthisina* externally.

Subgenus MONOBOLINA, Salt.

Monobolina, Salter, Mem. Geol. Surv. Great Britain, vol. iii, p. 334, 1865.

Shell resembling *Obolus;* broad; external surface radiately striated; muscular scars united closely along the central line.

Type. *Monobolina plumbea*, Salt., Siluria 2nd Ed. p. 50, Fos. 8, fig. 1, 1859. Dav., Sil. Brach. p. 61, pl. iv, fig. 20, 27.

Fossil in the Silurian formation of Gt. Brit.

The *Obolus? Salteri*, Dav., Sil. Brach. pl. iv, fig. 28, 29, appears to be more nearly related to the *Lingulas* with an internal mesial ridge than to any of the *Obolinæ*.

Genus SPONDYLOBUS, McCoy.

Spondylobus, McCoy, An. Nat. Hist. viii, 2, p. 407.

Suborbicular, slightly narrowed toward the short indistinct hinge-line; nearly equivalve, flattened. Hæmal valve with a slightly excentric apex, beneath which, on the interior, the substance of the valve is thickened into a wide undefined boss. Opposite valve slightly longer, from the apex being perfectly margined and somewhat produced; channelled by a narrow triangular groove, the anterior end of which is flanked within by two very prominent, thick, conical, shelly bosses; representing hinge teeth. Substance of the valve thick, testaceous, not glossy; minutely fibrous but not distinctly punctured under a lens of moderate power except by the end of the fibres (McCoy).

Type. *Spondylobus craniolaris*, McCoy, An. Nat. Hist. 1851, p. 408.

Hab. Cambro-Silurian, McCoy.

NOTE. In the 16th Regents Report (1863), Prof. Hall figures, under the name of *Obolella ? polita*, a shell which he described as *Lingula ? polita*, in the Ann. Rep. Geol. Wisconsin, p. 24, 1850. He compares it with *Spondylobus* and *Obolella*, and doubtfully refers it to the last named genus. Owen gives an unrecognizable figure of the same shell under the name of Obolus (Appolinus ?) in his Geol. Rep. of Wiscon., Iowa and Minn., pl. i, B, fig. 9, 11, 15, 20. Prof. Hall describes the muscular impressions as follows: "The interior of the ventral ? (neural) valve has a broad, somewhat cordiform, subcentral duplicate muscular impression, with a raised margin. From the centre beneath the beak extends a low flatly rounded ridge, which reaches into and partially divides the muscular impression. On each side of this low ridge is a nearly flat, slightly elevated plate or thickening of the shell, which, extending forward, is continued in its outer limbs in a raised border nearly around the muscular impression; giving to the whole a broad spatulate form, leaving a space in front where the shell is marked by a few radiating or vascular impressions. On each side of the central elevated plate and at the anterior extremities of the cardinal line, are two smaller muscular impressions. There is a narrow groove beneath the apex of the valve and on each side an elongate thickened boss or pad." (That is to say the hinge line is broad, arched and thickened, with a mesial groove for the peduncle). "The dorsal ? (hæmal) valve has a narrow central muscular impression, the limits of which extend in an acute point below the middle of the shell; on each side is a broader limited area, reaching two-thirds the length of the shell, and extending into the cavity beneath the beak. The whole presents an ovate, somewhat cordiform area. No marginal muscular impressions have been observed in this valve. Apex emarginate, with a prominent pad (i. e. the thickened hinge line) or tooth-like process on either side." Hab. Lowest fossiliferous beds of the Potzdam sandstone (Hall).

The above description is not as clear as might be desired and needs revision. Assuming the relative identity of the valves, as Prof. Hall has indicated, the impressions are as follows:

In the neural valve the scars of the adjustor muscles are situated on each side between the outer edge of the visceral area and the extreme edge of the hinge line near its outer end. The visceral area is traversed by a broad mesial ridge projecting a little beyond the edge of the area and abruptly truncate. At the outer angles of this end of the ridge are the ovate (and somewhat anteriorly divaricate) scars of the anterior adjustors, before which is a broad, space, probably the seat of the anterior retractors. The visceral area is anteriorly prolonged into two narrow arms which pass between the lateral and median scars and nearly encircle the latter. (See pl. 6, fig. 5, 6.)

In the other valve the lateral scars are not visible; the anterior adductors seem from the figure to divarcate posteriorly, being very narrow and divided in the middle by a pointed lobe of the visceral area, and bounded on the outer sides by two broad pointed lobes of the same.

The position of the apex removes the shell from *Spondylobus.* The groove or emargination of the hinge line of both valves, as well as the form and position of the muscular scars, would also seem to prevent it from being placed in *Obolella.* It would seem to belong to an undescribed genus, but, in the absence of specimens, I do not feel warranted in characterizing it from figures alone, especially as the figures of *Obolella,* given by Mr. Billings, are very poor.

Since the first part of this paper was in type I have been indebted for facilities for study and other favors to Prof. Agassiz, of the Museum of Comparative Zoölogy, at Cambridge; Mr. Hyatt, of the Boston Society of Natural History; Prof. James Hall, State Geologist, of New York, Mr. J. G. Anthony; Mr. R. P. Whitfield, of Albany; Mr. Geo. W. Tryon, Jr., of the Philadelphia Academy of Natural Sciences, and especially to Mr. E. S. Morse, of Salem. To the last named gentleman I am indebted for the privilege of examining his beautiful anatomical drawings of various brachiopods, some of them taken from life, and for specimens of *Glottidia pyramidata.* Among Mr. Morse's drawings were some of a singular Sipunculoid worm, which would appear, from them, to have an anterior termination to the intestine, thus forming a notable exception to the general rule among worms. While dissenting entirely from the conclusions at which he has arrived, from his study of the brachiopods, I must express my full appreciation of his kindness in thus opening his portfolio for my examination, and of the value of his researches into the embryology and anatomy of this interesting group. It is to be hoped that in his forthcoming memoir upon the subject he will give us *his* definition of a mollusk and of a worm, in order that we may more clearly comprehend the motives which have led him to unite two-thirds of the *Molluscoidea* with the Annelids.

I would add that, after an examination of some three hundred specimens of *Terebratula cubensis*, Pourtales, and a critical comparison of them with a large series of *T. vitrea*, that I have been forced to the conclusion that the two species are distinct, though closely allied; while among the specimens dredged by the Coast Survey Expedition I found some which seemed to be unmistakably *T. vitrea*. The characters appeared to be about as follows:

T. vitrea.	*T. cubensis.*
Lateral margins horizontally rectilinear.	*Lateral margins* flexuous.
Hæmal valve rounded ovate.	*Hæmal valve* quadrangulate.
Loop with its sinuosity indented before, with a sharp point behind.	*Loop* indented behind, with a rather broad, squarish prolongation in front.
Hinge teeth close together, slender.	*Hinge teeth* more widely separated, stout and thick.
Deltidium narrow, small.	*Deltidium* wider, longer.
Shell somewhat compressed.	*Shell* inflated. *Foramen* generally larger in proportion.

I have been thus explicit, as several excellent foreign naturalists have expressed the opinion that the species are identical. I have not had an opportunity of making a comparison of *T. cubensis* and *T. uva*, Brod.

The remarks in this paper upon the species described by Dr. A. A. Gould may possess some additional significance from the fact that they are made from an examination of his original type specimens.

Reference to Plates.—Plate 6.

Fig. 1. *Terebratella caurina*, Gld., normal; nat. size.
2. } " " " varieties; " "
3. }
4. " *suffusa*, Rve.; loop. nat. size.
5. "*Obolella*" *polita*, Hall. Interior of neural valve, somewhat reduced from Hall's figure.
6. Same; interior of hæmal valve.

7. *Obolella chromatica*, Bill., from Billings.
8. *Centronella*, Bill.; showing the loop.
9. Loop of *Magasella* (? var.) *lævis*, Dall.; twice nat. size.
10. Side view of same, enlarged.
11. Profile of apophyses of *? Magas patagonica*, Gld.; enlarged twice nat. size.
12. Interior of hæmal valve of the same enlarged one-half.
13. *Magasella* (? var.) *lævis*, Dall.; twice nat. size.

Plate 7.

Fig. a. Interior of neural valve of *Waldheimia Raphaelis*, Dall., showing muscular impressions.

b. Interior of hæmal valve of do., nat. size.

c. Side view of *Waldheimia Raphaelis*, Dall.; nat. size.

d. Anterior view of do.

e. Profile of loop of do., with one of the crura and part of the left hæmal process removed, to show outline of septum.

f. Hæmal valve of *Laqueus californicus*, showing the loop; reduced to one-half nat. size.

g. Profile of loop of *Laqueus suffusus*, Dall; magnified three times, linear.

h. *Laqueus suffusus*, Dall., nat. size.

s. Interior of hæmal valve of do., magnified.

Plate 8.

Fig. 1. *Glottidia albida*, Dall.; nat. size.

2. " " " interior of neural valve, nat. size.

3. a, section of do. near beak, magnified. b, c, section of lamellæ.

4. Section of lamella magnified 500 diameters, showing the dark horny layers and white calcareous layers.

5. Section of thickest part of valve, same power, showing the layers.

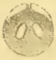
6. Section of external horny layer, magnified 900 diameters, showing fibrous structure.

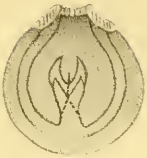
7. *Epithyris elongatus*, Schl., after Davidson; from a broken specimen.
8. Cardinal process of *Wald. venosa*.
9. " " " *Laqueus californicus*.
10. Posterior view of cardinal process of *L. californicus*.
11. Ditto of *W. venosa*.
12. Side view of apophyses of *Meganteris archiaci*, after Suess.

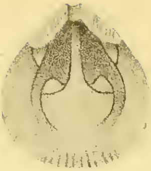
12*a*. View of the cardinal border of the same.

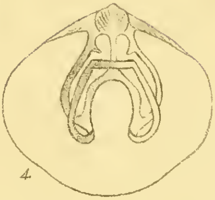
13. Apophyses of *Ismenia sanguinea*, enlarged.
14. Apophyses of *Kingena lima*, after Davidson.

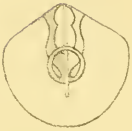
American Journal of Conchology.—1870. Plate 6.

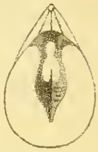

7

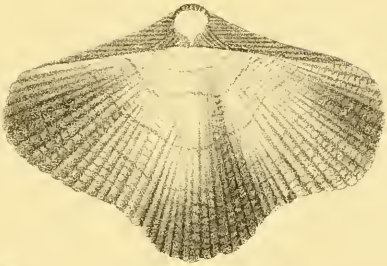

6

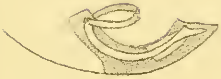

5

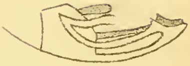

4

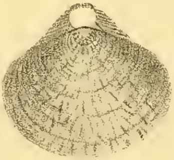

9

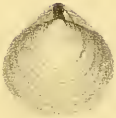

8

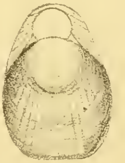

1

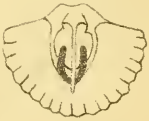

10


11


2

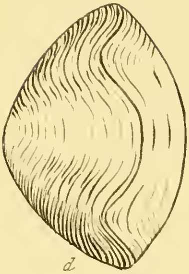

13


3

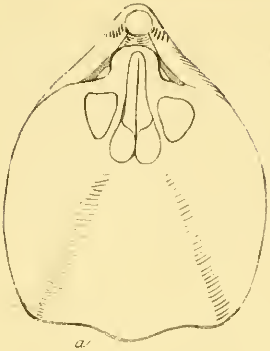

12

W. H. DALL, DEL.

Dall, On Brachiopoda.

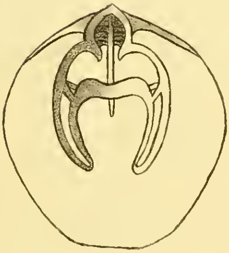


d

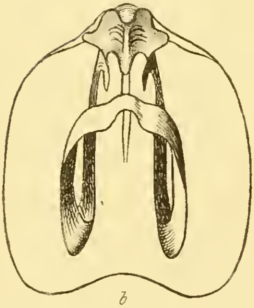


a

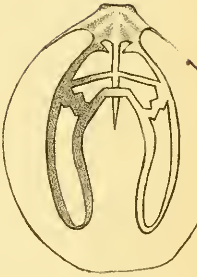
h



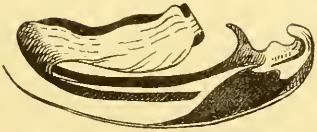
s



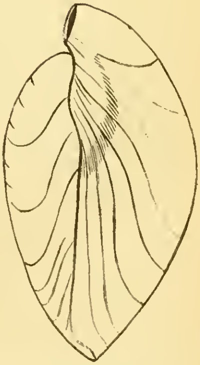
b



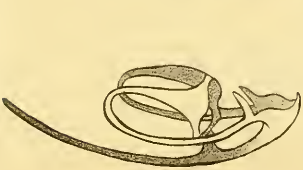
f



e



c

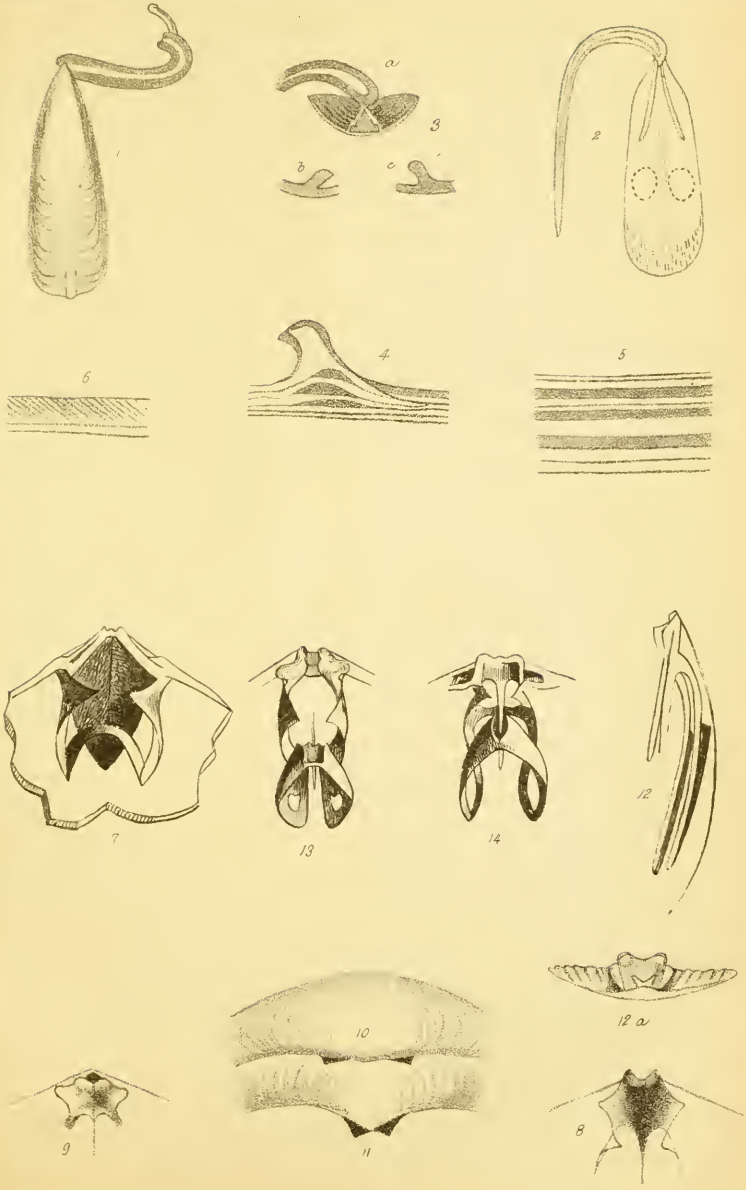


g

Dall, On Brachiopoda

W. H. DALL, DEL.

American Journal of Conchology. 1870. *Plate 8*



W H DALL, DEL.

Dall On Brachiopoda.